

Educational Communications and Technology Yearbook

Anna Wing Bo Tso
Alex Chi-keung Chan
Wendy Wing Lam Chan
Peter Edward Sidorko
Will W. K. Ma *Editors*

Digital Communication and Learning

Changes and Challenges

 Springer

Educational Communications and Technology Yearbook

Series Editor

Will W. K. Ma, Hong Kong Association for Educational Communications and
Technology (HKAECT), Hong Kong, Hong Kong

The Hong Kong Association for Educational Communications and Technology (HKAECT) was established in 1989. Its first conference was organized in 1990, addressing “The Role of Educational Communications and Technology in Year 2000,” with speakers coming from the United States, China, and Taiwan to discuss the outlook on educational communication and technology. Throughout these years, the HKAECT has held a number of international conferences, symposiums, workshops, and talks with various themes to provide a platform to enable rich exchanges for academicians, practitioners, and professionals in the fields of communication and education to discourse about the shaping and changing issues on education, communication, and technology. This Yearbook series collect presentations from the annual international conferences held by the HKAECT. Chapters would come from the annual global call for submission, and be selected based on blind review from international review board. Subject areas include but not limited to communication, new media, news media, broadcast journalism, democracy and the media, entertainment and education, learning analytics, AI in education, game-based learning, ubiquitous learning, MOOCs, open education, instructional design, social context and learning environment, social media, risk and ethics in new media, etc.

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Preface

The HKAECT 2021 International Conference on *A New Paradigm for Digital Communication and Learning: Changes and Challenges* was co-organized by the Hong Kong Association for Educational Communications and Technology (HKAECT) and The University of Hong Kong Libraries. It was held on 24–26 June 2021, online and live, at the Ingenium of the Main Library, The University of Hong Kong, Hong Kong SAR, China.

Since the onset of COVID-19, online teaching and learning has played an increasingly vital role in shaping a new education culture in various education settings across different countries. Needless to say, online education, alongside new media, has provided ample benefits to educators and students. Nevertheless, virtual lessons and communication conducted synchronically (real-time) and asynchronously alike do bring problematic issues such as insufficient technical support, inefficient classroom management, reduced interaction between teachers and students, and growing concerns over privacy and security. With a view to shedding light on the global education climate in the midst of the pandemic, HKAECT International Conference 2021 provided an academic platform for discussing the pros and cons, constraints, and potential risks as the new paradigm for digital communication and learning takes place.

Through open calls for paper submissions, the Conference Committee received close to 60 proposals. Upon completion of the rigorous peer review process, 20 high-quality manuscripts are chosen for the post-conference edited volume. The book is broadly categorized into five parts under five main themes—Part I: Assessment and curriculum (chapters “[Self and Peer Assessment in the Socially Distanced Classroom: An Action Research for Improving English Oral of Asian Students](#)”, “[Online Teaching and Assessment Practices During COVID-19 Crisis: Perspectives from University Students](#)”, and “[Designing Inclusive and Diverse Artificial Intelligence \(AI\) Curriculum for K-12 Education](#)”), Part II: Creativity and social media (chapters “[The Need of Having Journalistic Creativity in Journalism Education: A Review of the Literature on Media Creativity and Look](#)

Beyond”, “Social Experiential Learning for Zero Waste Education in a Liberal Arts University”, “Enhancing the Awareness of e-Mental Health Messages: The Effects of Narrative, Emoji, and Relevance”, and “Exploring a Self-paced Online Course Design, Learning Engagement, and Effectiveness on Anti-cyberbullying Topic for Adolescents in Hong Kong”), Part III: Language learning and teaching (chapters “Teaching in the Time of Corona(Virus): A Cross-Institutional Study of Online English Language Teaching in Hong Kong Higher Education”, “ICT Virtual Multimedia Learning Tools/Environments: Role and Impact on ESL Learners’ Development of Speech Accuracy—YouTube as an Example”, “Chinese Second Language Learners’ Perceptions of Gamification in an Informal Learning Environment: Duolingo as a Case Study”, and “An Exploration of Developing ICT-Related Pedagogical Strategies in the Professional Development of EFL Teachers in Vietnam”), Part IV: Online learning and blended learning (chapters “An Adventure in Flipping a Secondary School Mathematics Classroom During the COVID-19 Pandemic”, “Exploring the Relationships Between Online Learning, Motivation, Social Presence, and Learning Efficacy”, “A Review on Blended Learning for English Language Teaching in Indonesian Higher Education”, and “Communication Noise in E-learning During the Pandemic and How to Reduce It: Perspectives from University Students and Teachers”), and Part V: Learning environment and design (chapters “An Empirical Study on Peer Discussion About Statistical Evidence in Computing Laboratory”, “Effective Learning Through Project-Based Learning: Collaboration, Community, Design, and Technology”, “The Role of Online Course Design in Associating Second Language Learners’ Motivation and Self-regulated Learning Strategies in Non-formal Online Learning Contexts”, “An Empirical Study on the TEAMS Online Teaching Experiences at a University in Taiwan”, and “From Big Data to Blockchain: Promises and Challenges of an All-Encompassing Technology in Education”).

We are grateful that the Conference has successfully attracted numerous renowned scholars and experienced practitioners to share their latest research, recent observations, and recent teaching experiences with the conference participants from Australia, Asia, Europe, the U.K., and the U.S.A. On behalf of the Conference Organizing Committee, we would like to take this opportunity to express our heartfelt gratitude to our keynote speakers, namely, Prof. Xun Ge, President of AECT and Professor of The University of Oklahoma, Prof. Bart Rienties of The Open University, U.K., Timothy K. F. Hew of The University of Hong Kong, and Mr. Nick Melchior of Springer. We would also like to show our sincere appreciation for the hard work of all chapter contributors and peer reviewers. Without the helping hand and great support of our HKAECT friends, this book volume would not have been possible.

October 2021

Anna Wing Bo Tso
 Alex Chi-keung Chan
 Wendy Wing Lam Chan
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Contents

Assessment and Curriculum

Self and Peer Assessment in the Socially Distanced Classroom: An Action Research for Improving English Oral of Asian Students	3
Anna Wing Bo Tso	

Online Teaching and Assessment Practices During COVID-19 Crisis: Perspectives from University Students	19
Annie W. Y. Ng	

Designing Inclusive and Diverse Artificial Intelligence (AI) Curriculum for K-12 Education	33
Thomas K. F. Chiu	

Creativity and Social Media

The Need of Having Journalistic Creativity in Journalism Education: A Review of the Literature on Media Creativity and Look Beyond	49
Wendy Wing Lam Chan	

Social Experiential Learning for Zero Waste Education in a Liberal Arts University	67
Paulina Pui Yun Wong and Gary Wai Chung Wong	

Enhancing the Awareness of e-Mental Health Messages: The Effects of Narrative, Emoji, and Relevance	87
Chi-Keung Chan and Kelly Ka-Wai Chan	

Exploring a Self-paced Online Course Design, Learning Engagement, and Effectiveness on Anti-cyberbullying Topic for Adolescents in Hong Kong	107
Min Lan	

Language Learning and Teaching

Teaching in the Time of Corona(Virus): A Cross-Institutional Study of Online English Language Teaching in Hong Kong Higher Education 125
Noble Po Kan Lo and Sumie Chan

ICT Virtual Multimedia Learning Tools/Environments: Role and Impact on ESL Learners’ Development of Speech Accuracy—YouTube as an Example 143
Azzam Alobaid

Chinese Second Language Learners’ Perceptions of Gamification in an Informal Learning Environment: Duolingo as a Case Study 183
Liu yufeng Li and Breffni O’Rourke

An Exploration of Developing ICT-Related Pedagogical Strategies in the Professional Development of EFL Teachers in Vietnam 203
Tuyen Van Nguyen, Helena Hingwa Sit, and Shen Chen

Online Learning and Blended Learning

An Adventure in Flipping a Secondary School Mathematics Classroom During the COVID-19 Pandemic 223
Man Keung Chun and Chung Kwan Lo

Exploring the Relationships Between Online Learning, Motivation, Social Presence, and Learning Efficacy 239
Samuel Cheuk-Yin Law, Raymond Chi-Fai Chui, Nicholson Yat-Fan Siu, and Chung Hau Ching

A Review on Blended Learning for English Language Teaching in Indonesian Higher Education 253
Putri Gayatri, Shen Chen, and Helena Sit

Communication Noise in E-learning During the Pandemic and How to Reduce It: Perspectives from University Students and Teachers 279
Zhao Xun Song, Jing Wu, and Hsin Li Hu

Learning Environment and Design

An Empirical Study on Peer Discussion About Statistical Evidence in Computing Laboratory 299
Ken W. Li and Merrilyn Goos

Effective Learning Through Project-Based Learning: Collaboration, Community, Design, and Technology 317
Will W. K. Ma

The Role of Online Course Design in Associating Second Language Learners' Motivation and Self-regulated Learning Strategies in Non-formal Online Learning Contexts	343
Shuqin Zhai and Min Lan	
An Empirical Study on the TEAMS Online Teaching Experiences at a University in Taiwan	365
Pei-Ying Wu, Kwan-Keung Ng, and Shao-Fu Li	
From Big Data to Blockchain: Promises and Challenges of an All-Encompassing Technology in Education	383
Jae Park	
Author Index	399

Assessment and Curriculum

Self and Peer Assessment in the Socially Distanced Classroom: An Action Research for Improving English Oral of Asian Students



Anna Wing Bo Tso

Abstract The aim of this action research study is to share the experience of introducing self and peer assessment to an online English presentation course conducted for English as a Foreign Language (EFL) students at a university in Hong Kong in Spring 2020. Disrupted by the COVID-19 outbreak, face-to-face English oral classes were made to go online in the pandemic. While the reduced face-to-face interactions caused inconvenience to the English oral class, online teaching had also created an opportunity for introducing alternative assessment methods in the EFL oral course. With reference to the current theories of self and peer assessment, this paper looks into how the online platform had advantaged self and peer assessment of EFL students' oral performances during the research period. Students' perceptions of self and peer assessment in the EFL oral class will also be discussed.

Keywords Action research · EFL oral practice · Self and peer assessment · Teaching during the pandemic

1 Introduction: English Oral in the EFL Classroom During COVID-19

Due to the COVID-19 outbreak since January 2020, for four consecutive semesters across two academic years, face-to-face lessons at university in Hong Kong had been replaced by real-time Zoom classes and digital learning so as to practice social distancing. Such changes had brought a great deal of unexpected challenges to the delivery of English language courses, in particular a course that focuses on oral presentation skills and public speaking. Because of the constraints of Zoom classes, public presentation aspects such as the speaker's posture, use of gestures, eye contact with the audience, facial expressions, and body language can no longer be assessed in

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the same way they used to be assessed in face-to-face classes. In addition, interactions between the speaker and the audience are bound to be different, if not reduced.

Despite all the limitations in the socially distanced classroom conducted online, digital technology has brought new opportunities for English classes. Maximizing the benefits that digital learning platforms can bring to the students has become the current trend. As a matter of fact, years before the COVID-19 pandemic, online peer assessment has already been performed increasingly due to the ease and convenience of doing so (van Popta et al., 2017). For example, while the learning environment via Zoom does not facilitate non-verbal communication training, the EFL teacher can gear the focus toward verbal communication training, which includes such aspects as pronunciation, intonation, speaking pace, fluency, presentation structure, and time management. Because of the recording function of Zoom, all verbal communication features of the students' presentations can now be easily recorded, archived, replayed, and studied closely by the teacher, the audience members, as well as the student presenters themselves. In short, as Zoom classes are conducted during the pandemic, it is high time for EFL teachers to incorporate self and peer assessment to increase students' motivation, enhance self-directed learning, and train up their English oral proficiency.

In this paper, I will share my observations of the advantages, feasibility, as well as limitations of using self and peer assessment in an EFL oral class conducted online during the pandemic. In the following, a brief literature review of self and peer assessment will be provided before moving on to the detailed discussion of the action research on self and peer assessment for improving English oral of Asian students.

2 Literature Review

2.1 *Self-assessment as a Formative Assessment Tool*

Different from the typical teacher assessment, self-assessment is a kind of alternative assessment that employs a free-assessment approach (Jung, 2016, p. 3). It is a "wide variety of mechanisms and techniques through which students describe (i.e., assess) and possibly assign merit or worth to (i.e., evaluate) the qualities of their own learning processes and products" (Panadero et al., 2016, p. 804). While research indicates that self evaluation and self-generated feedback are associated with academic gains (Zimmerman & Schunk, 2011), self-assessment has a major drawback—it causes a conflict of interest as the student plays the role of a self-assessor. According to Tejeiro et al. (2012), students often tend to overestimate their own performance especially when summative self-assessment is counted toward final grades. After all, students do want to obtain the highest possible marks. On the other hand, some students who lack confidence in their abilities tend to give themselves low grades, which can bring negative impacts on the students and even the institution. To avoid

the conflict of interest, it is best if self-assessment is constantly monitored by teachers and carried out in the formative form. As Andrade (2019) points out, “the purpose of self-assessment is to generate feedback that promotes learning and improvements in performance. This learning-oriented purpose of self-assessment implies that it should be formative: if there is no opportunity for adjustment and correction, self assessment is almost pointless.” (p. 2). To a large extent, self-assessment in summative assessment will only succeed if the student assessors are well-trained. In other words, the main aim of self-assessment is to improve students’ understanding of the evaluation criteria and enhance their self correction ability.

2.2 Peer Assessment: Advantages and Limitations

Apart from self-assessment, peer assessment is also in the trend in educational settings because of technological advancement. It is defined as “a frequently adopted learning strategy to assist students in rating and offering instant feedback to peers from the perspective of instructors, which has good potential for fostering students’ critical thinking.” (Fang et al., 2021, p. 1155). Through the reciprocal process, not only can the assessee benefit from receiving comments from peers, the student assessors can also take advantage of the assessor’s role and improve their own learning. “This is achieved by students having to critique and review someone else’s work and thereby reflect on their own understanding or performance” (Chin, 2007, p. 13). Given sufficient guidance and support from the teacher, students can be trained to distinguish high-quality works from low-quality works, provide constructive feedback, reflect on their own works, avoid the same mistakes, and retain and/or further improve their own works (Seifert & Feliks, 2019). Besides improving students’ academic performance, peer assessment is also known to be an effective tool for enhancing such student capabilities as team communication (Grice et al., 2013; Kearney, 2013), teamwork, and collaboration (Cunningham et al., 2016).

Alongside self-assessment, peer assessment is becoming increasingly important as an alternative method (Cheng & Warren, 2005) in higher education because it can be effectively implemented online without much burden in the logistics (Hsu, 2016; Li & Gao, 2016). In the past two decades, numerous research studies have found that both self and peer assessment enhance self-regulated learning and help students become autonomous learners (Boud et al., 2014; McDonald, 2016; Xu & Zhu, 2011). Meanwhile, problems brought by self and peer assessment have also been identified. Regarding the efficacy of self-assessment, it is pointed out that “[o]ne of the main areas of uncertainty with regard to self-assessment is learners’ objectivity and capacity to view their own attainments” (Ekbatani, 2011, p. 67). Likewise, it is noticed that students who participated in self-assessment tended to overrate themselves when self-assessment was implemented (Henderson, 2017; Vuma & Sa, 2017). Instant guidance for student assessors and regular marking standard monitoring are required. Lapham and Webster (2003) also noticed that peer assessment could bring some negative effects, such as “[p]rejudice, favouritism, friendships and ethnic division”

(p. 188). Nevertheless, the pros of self and peer assessment appear to have outweighed the cons according to research. This action research study aims to reveal what works in the undergraduate ESL oral class and how the potential benefits mentioned by the researchers can be maximized in the online learning context.

3 Background of the Study

3.1 *The School Environment and Scheme of Work of the Online English Oral Course*

Since students' English language proficiency is positively correlated to their academic achievements (Tso & Chung, 2016), the university in which I conducted the action research had made it compulsory for most year-one students to take a five-credit course called *Presentation Skills*, a foundation English course that I taught in Spring 2020. There were no set books for the course, and students were provided with study materials designed by the lecturer, who was also free to design his/her own notes and teaching materials to suit the needs of the students. This flexibility became essential as there was the COVID-19 outbreak, for the teaching focus and materials had to be adjusted for full online learning. There were 4 contact hours per week (2 h of recorded lecture + 2 h of real-time Zoom tutorial) and a total of 52 contact hours for the course, which consisted of five units, all of which aimed at brushing up the listening and speaking skills of EFL students. To pass the course, students must pass both the continuous assessment (40%) and the final examination (60%).

Because of the sudden COVID-19 disruption in 2020, *Presentation Skills*, which used to be a face-to-face course, became an online course. All oral assessment was turned into recorded oral presentations to be submitted online through Moodle. Since facial expressions, gestures, and body movement, in recorded presentations could not be assessed the same way as in real-time face-to-face presentations, the marking rubrics were adjusted—originally, 22% of the scores were allocated for the category of “delivery skills”, which include visual, gestural and spatial semiotics such as eye contact with audience, facial expression, gesture, posture, and body movement (Tso & Lau, 2019). Now, the category of “delivery skills” merged with that of “language skills,” with 43% of the scores allocated for linguistic and audio semiotics like the use of vocabulary, fluency, tone and manner, pronunciation and accuracy, pace and intonation (Tso & Lau, 2019) (Fig. 1).

Now that much of the focus had turned from “delivery skills” to “language skills,” students were given the freedom to decide whether they would like to submit video clips (MP4) or audio clips (MP3) of their recorded oral presentations. Knowing that their oral presentations would be peer assessed, the majority of students expressed their preference to submit audio clips instead of video clips to keep their privacy and avoid embarrassment.

Fig. 1 The original marking rubrics for the face-to-face English presentation course

ORAL PRESENTATION MARKING RUBRICS					
Content, Organization & Strategy (57%)					
Content & Organization (37%)	Excellent (32-37)	Good (24-31)	Satisfactory (16-23)	Average (8-15)	Poor (0-7)
<ul style="list-style-type: none"> ✓ Gain the audience's interest ✓ State purpose clearly ✓ Identify the topic and define the scope of the presentation ✓ Exhibit knowledge of content in the presentation ✓ Support the main points with details ✓ Document facts where necessary ✓ Provide transitions ✓ Summarize main points ✓ Close smoothly 					
Presentation Strategies (20%)	Excellent (17-20)	Good (13-16)	Satisfactory (9-12)	Average (5-8)	Poor (0-4)
<ul style="list-style-type: none"> ✓ Presentation well-planned and well-coordinated (planned transitions/coordinate visuals with consistent style) ✓ Time management (within the time limit specified) ✓ Question handling (anticipate questions; provide positive, sound and relevant answers) ✓ Use of visual aids 					
Subtotal:					/57
Language & Delivery Skills (43%)					
Language Skills (21%)	Excellent (18-21)	Good (14-17)	Satisfactory (9-13)	Average (5-8)	Poor (0-4)
<ul style="list-style-type: none"> ✓ Use of vocabulary ✓ Fluency ✓ Tone and manner (Use of you-view, reader benefit, etc.) ✓ Pronunciation & Accuracy 					
Delivery Skills (22%)	Excellent (19-22)	Good (14-18)	Satisfactory (9-13)	Average (5-8)	Poor (0-4)
<ul style="list-style-type: none"> ✓ Eye contact with audience ✓ Voice projection, pace and intonation ✓ Gesture, posture & facial expression 					
Subtotal					/43
Total					/100
Comments:					

3.2 *Students' Abilities and My Approach in Teaching English Oral Online*

The 27 year-one students in my online oral class were mostly Hong Kong students who had passed the DSE English language examination, but there were also students from China, India, and Nepal. To find out how I could help my students learn English more confidently and independently, I designed a set of questionnaires for my students. The survey was conducted in week 1 through Google form. From the list of oral activities, including “giving a presentation,” “making a speech in public,” “having a group discussion,” “making telephone conversations,” and “communicating in meetings,” 87% of the participants graded “making a speech in public” as very difficult, i.e., score 8 on a scale of 1 to 10, with 1 being the least difficult and 10 being the most difficult. Thus, “making a speech in public” was made the main focus in the study. Speaking of “making a speech in public,” there can be three kinds of public speeches, namely face-to-face, online real-time, and online asynchronously. Traditionally, “making a speech in public” in an English presentation course refers to delivering a speech at a lectern in front of the audience members who are physically present inside the classroom. However, due to the COVID-19 disruption, the format of the “public speeches” had gone digital. In the *English Presentation* course, the online asynchronous speech format was used, and it was warmly welcomed by students mainly because of two reasons: firstly, the virtual public speech format allows multiple retakes and revisions; secondly, the digital format is similar to the kind that *YouTubers* and key opinion leaders (KOL) create and present to their fans and audiences from all around the world. By a fortunate stroke of serendipity, the pandemic urged both the teacher and students to keep abreast of the times and adapt the presentation tasks online asynchronously.

4 Research Questions

With a special focus on technology-assisted self and peer assessment, this action research investigated the following questions:

- i. To what extent did online self and peer assessment improve EFL Asian students' public speaking skills in English?
- ii. How did EFL Asian students at university perceive self and peer assessment through the online platform?

This paper has sought the answer to the first question through the triangulated data generated from students' oral performances, student assessors' evaluation forms, the student survey, and the focus group interviews. The answer to the second question, on the other hand, was sought through the student survey and the focus group interviews.

5 Research Methodology

To find out the effectiveness of online self and peer assessment in enhancing EFL Asian students' English oral proficiency, this study employed a four-stage action research model (Mertler, 2019) that allows the “observing-doing-observing-adjusting” cycling and spiraling pattern to collect data through students' recorded speeches in MP3, filled evaluation forms, questionnaires, and focus group interviews.

5.1 Action Research Cycle 1: The Planning Stage

In week 1 of the action research (last week of January 2020), the concept of self and peer assessment was introduced to the 27 full-time year-one university students. The purpose and action plan of the research were also stated and outlined for the participants. It was explained clearly to all participants that the alternative assessment to be employed was solely for experimental and research purposes. The scores given in the self and peer assessment process would by no means affect the original assessment system and the grade they would get for the oral course. Students were given the marking rubrics on Moodle. The assessment criteria and grade descriptors were listed clearly and neatly in a table format. In the recorded lecture, the lecturer also explained how the marking guide should be used. Students could also use the Moodle discussion forum should they need to address any issues arising from the assessment process.

After the marking criteria had been explained, students were given a 20-min lecture on how to make a good speech. A sample speech outline was also shared on Moodle. In the real-time Zoom tutorial, students were given a script extracted from Winston Churchill's famous speech, “We shall fight them on the beaches.” Students were divided into groups to discuss the language techniques used in Churchill's speech.

5.2 Action Research Cycle 2: The Acting Stage

In week 2 of the action research (mid-February 2020), the 27 students listened to three samples of assessed presentation which were five-minute speeches with different qualities (excellent, satisfactory, or unsatisfactory) in the lecturer's recorded lecture archived on Moodle. Students could replay the samples as many times as they wanted at their own pace. When students got more familiar with the assessment system, in the real-time Zoom tutorial, they were asked to listen to two speeches and practice assessing them according to the marking guide introduced in Jan 2021. After the marking, students were allowed time to discuss their judgment with their peers. When they had finished the discussion, they were asked to compare the marks and

comments given by the tutor, their classmates, and themselves. They were encouraged to ask questions when in doubt. Before the tutorial ended, 5 volunteer students were chosen to form the focus group of the action research. The function and role of the focus group were explained. The five students were also informed of the special arrangements for them in action plan weeks 3 and 4.

5.3 Action Research Cycle 3: The Developing Stage

In week 3 of the action research (early March 2020), students started to prepare and make their own five-minute speech into an audio clip. Given three speech topics, students were free to choose a topic which they liked. With reference to the speech outline given to them previously, they recorded their five-minute speeches in MP3 and shared it on Moodle's discussion forum. Next, students were instructed to assess their own oral clip with the marking guide introduced in week 1. When the self-assessment was completed, the evaluation forms were submitted through Moodle. Upon completion of the marking, the tutor also shared the teacher's evaluation scores and remarks with the students. By comparing the self-assessment and teacher assessment scores and comments, students got to learn more about the criteria for evaluating a public speech in English. In addition, a follow-up interview with the focus group was conducted within week 3 to find out students' feedback toward self-assessment.

5.4 Action Research Cycle 4: The Reflecting Stage

In week 4 of the action research (mid-March 2020), students chose 1 out of 3 speech topics and again made their own five-minute speech into an audio clip. After recording and submitting their speeches in the MP3 format, students were instructed to self-evaluate their own work, and carried out peer assessment for one another. The filled self and peer evaluation forms were collected through Moodle. Last but not least, the tutor returned the marksheets to all students. Students were able to compare the marksheets generated in self-assessment, peer assessment, and teacher assessment.

Same as before, a follow-up interview was conducted with the focus group in week 4. In addition, all students who participated in the self and peer assessment activities were asked to complete a questionnaire that examined their views on the validity, reliability, and usefulness of online self and peer assessment in their English oral learning process.

6 Data Collection

Four different types of data were collected in the action research. First of all, the recorded oral speeches in MP3 were collected in weeks 3 and 4 of the research plan. The quality of the speeches made in week 4 was compared with that of the speeches made in week 3. Improvements and/or changes in style and tone were also noted. Secondly, the filled self and peer evaluation forms were collected. The grade, scores, and comments written on the evaluation forms were examined with reference to the recorded speeches. Thirdly, two follow-up group interviews with the focus group were conducted in weeks 3 and 4. Students’ comments and feedback regarding the usefulness, validity, reliability, and any concerns about online self and peer assessment were of critical significance to the study. Last but not least, filled questionnaires about participants’ perception of self and peer assessment were collected from the oral class. To a large extent, the survey was expected to reflect the EFL undergraduate students’ attitudes and readiness to accept the incorporation of self and peer assessment through the digital platform.

7 Findings and Discussions

7.1 Learning Outcomes

In the survey, student participants indicated that both online self and peer assessment had helped them improve their English oral and speech making skills. With regard to self-assessment, about 70% of the students agreed that through self-assessment, they understood the evaluation criteria for grading and assessing speeches. Also, 60% reflected that they were able to make a better speech after undergoing self-assessment in week 3 (Fig. 2).

To what extent do you agree or disagree with the following statements?	Agree	Neutral	Disagree
#3: Now I know how a speech is assessed and graded.	70.37% (n = 19)	29.63% (n = 8)	0% (n = 0)
#7: I can make a better speech after self assessment.	60% (n = 16)	40% (n = 11)	0% (n = 0)

Fig. 2 The survey result of Questions 3 and 7 in the student questionnaire

To what extent do you agree or disagree with the following statements?	Agree	Neutral	Disagree
#8: I have learnt more from listening to my classmate's speech.	72% (n = 19)	26% (n = 7)	2% (n = 1)
#9: I have spotted some errors in my classmate's speech.	52% (n = 14)	37% (n = 10)	11% (n = 1)

Fig. 3 The survey result of Questions 8 and 9 in the student questionnaire

Seventy-two percent of the students also expressed that peer assessment was helpful in enhancing their listening skills. Over half of the students also noted that they were able to spot mechanical mistakes in their peer assessee's speeches (Fig. 3).

However, student assessors were not confident of their own marking. A significant gap between the student assessors and the teacher assessor was observed. Students showed a tendency of over-grading speeches, not to mention writing no or only brief comments compared to the EFL teacher. Some student assessors were only able to give vague comments like "You made some grammatical mistakes" and "The speech can be more fluent" in the evaluation form, which were too general and close to useless. In fact, only 42% of the students thought they were able to correct their own mistakes during self-assessment. They might only discover their own grammatical and pronunciation mistakes only when they read the teacher assessor's comments and replayed their own recorded speech.

Nevertheless, a number of student assessors were still able to indicate pronunciation mistakes made by their fellow classmates. For example, one of the student assessors wrote in the evaluation form, "many regular verbs in the past participle form, such as "sustained," "defined," "carried," etc. were mistakenly pronounced with the voiced ending /dId/." This had been echoed by Lucy, a participant in the focus group interview. In the second interview conducted in cycle 4 of the action research, Lucy mentioned:

My peer assessor has corrected my mispronunciation. Before the peer assessment, I wasn't aware of the mistakes I often made when pronouncing the past tense form of regular verbs. Thanks to the reminder given by my peer assessor, I realized now that verbs like "faced", "attacked", "backed" and "refused" should be pronounced without voicing the 'ed' endings. As for past tense verbs that ended with "ded" and "ted", I need to keep the /dId/ sound, as in "masterminded", "intended", and the /tId/ sound, as in "admitted" and "committed".

While most students could only discover their own mechanical mistakes through teacher assessment and peer assessment, some students did show clear awareness of the faults they made in the speech structure through self-assessment. For instance, Eddie of the focus group revealed in the interview that he did not know how to end his speech. Indeed, he stuttered a lot toward the end of the speech and ended his speech

abruptly by saying, “time’s up already.” After listening to his own recorded speech repeatedly in the self-assessment, Eddie became conscious of the shortcoming in the speech ending. In the second recorded speech, Eddie concluded by providing several recommendations to the problem addressed in the speech topic. He also managed to wrap his speech up with a concluding sentence, “I hope this nightmare could be ended [sic] in the near future.”

Similarly, Jessie, another student in the focus group, had also made some improvement in striking a balance in the structure of her speech. When she first made her speech about her view on breast implants, she argued against the issue without considering the opposing views held by others in society. She made the statement, “putting into yourself something that doesn’t belong to you is the biggest nonsense I’ve ever heard of.” This made her speech sound subjective and unsympathetic. After the self-assessment and teacher assessment, Jessie realized the problem in her speech through the recording. Then, in her second speech, Jessie started by giving a definition of the subject matter. Then, she spent an equal amount of time on discussing both views (i.e., Ghosts exist, and ghosts do not exist) before she expressed her personal view at the end. With the implementation of online self and peer assessment, most students became more aware of the style, tone (register), structure, pronunciation, and grammar in their speeches.

Apart from the improvement in the oral performance, students also showed that they had become more enthusiastic and reflective in learning. For example, after cycle 4, the focus group suggested that they should revise the oral recordings after receiving the ratings from self and peer assessment. They would like to submit the revised speeches. From the survey, 56% of the student participants revealed that they welcomed self and peer assessment in future; 36% remained neutral about the statement, and only 8% of the students disagreed with the idea of having self and peer assessment in future.

Furthermore, from the filled evaluation forms collected in cycles 3 and 4 of the action research, I noticed that some participants had gradually become more confident of giving comments on others’ oral presentations. Although there was still limited written feedback written in the evaluation, the written feedback in cycle 4 had, to a certain extent, become more precise. For instance, instead of just giving a score for the conclusion of the assessee’s speech, one student assessor pointed out to the assessee that the speech had “ended in a rush.”

7.2 Feedback on Self-assessment

From the questionnaires, it appears that most participants perceived self-assessment as a positive and constructive learning process. 68% percent of the participants agreed that after the activity, they knew better how a speech is assessed and graded. 60% percent felt that they could make a better speech after the self-assessment. The responses from the group interviews added further evidence to the view. The focus group showed appreciation toward online self-assessment. They liked the speech

Table 1 EFL Asian students' views on self-assessment in the English oral course

Student feedback 1	"I have concerns that as assessors, not all of us are objective."
Student feedback 2	"Frankly, I don't have much confidence in doing self-assessment. I may have the tendency of over-rating myself."
Student feedback 3	"I think I may have under-rated myself? I only realized it only when I compared the grade and scores I achieved from the self-assessment and those from the peer assessment."
Student feedback 4	"We may need more samples for practice before conducting the self-assessment. To maximize the effect, more good speech samples should be provided for standardization."

archive on Moodle and they found it very convenient to upload, replay, and download their speeches from the online platform. However, students had shown concerns about over-rating, under-rating, and not being objective enough when conducting self-assessment (Table 1).

The feedback was in alignment with Ekbatani (2011)'s observation, which raises the concerns about student assessors' objectivity and assessment abilities. It can be foreseen that fairness would be of key concern should self-assessment become part of the formal assessment, be it in the face-to-face or online mode. While self-assessment provides a chance for students for self-reflection, it would be challenging for the teacher if he or she has to ensure students' honesty in self-assessment. The conflict of interest would make it hard for any student to fail himself or herself in the course. One suggestion for this loophole is that the students can work with the tutor to improve self and peer assessment. With the tutor's constant monitoring, the tutor can see more clearly what the students' needs, and self and peer assessment shall be more accurate and reliable. They can then be used as part of the formal assessment process. In the long run, the learning experiences students gained in the self and peer assessment may also help students prepare for their future employment when they will need to assess the quality of their own work and participate in performance management and appraisal processes.

7.3 Feedback on Peer Assessment

Compared to self-assessment, students had more reservation toward peer assessment. As reflected in the second focus group interview, students felt embarrassed and reluctant in giving negative comments and poor grades to their classmates, especially if the classmates were their good friends, and that the comments they made were saved and shown clearly to all online. The other negative feedback about peer assessment was that students were not confident of the ability and competence of student assessors. They were not sure of the validity and accountability of the grades, scores, and comments provided by their peers (Table 2).

Table 2 EFL Asian students' views on peer assessment in the English oral course

Student feedback 1	"It is especially hard to comment on a classmate harshly and give him/her a bad grade. I don't know how to avoid hard feelings when I need to give bad comments and a poor grade to a friend."
Student feedback 2	"My classmate did not know how to help me. Peer assessment is good only when the peer assessor is capable."
Student feedback 3	"I found mistakes in my classmate's speech, and then I realized I also made the same kind of mistakes."
Student feedback 4	"To improve, we can have peer assessment...that may create more pressure...well, pressure will push students to work harder."

The feedback collected from students supports the assertion made by Seifert and Feliks (2019) who state that for peer assessment to be effective, students must reflect on work and the assessment process under close guidance from the teacher. It also shows that Lapham and Webster (2003)'s concerns about "[p]rejudice, favouritism" and "friendships" are real (p. 188). In spite of the unfavourable feedback, the participants did agree that there were some advantages in using peer assessment. In the questionnaire survey, 72% of the participants agreed that they actually learnt more from listening to their peer's speech in the peer assessment. This finding echoes Fang et al. (2021)'s study that peer assessment does foster students' critical thinking.

8 Conclusion

In the Spring term of 2020, over a short period of four weeks, I incorporated self and peer assessment into an online English presentation course for undergraduates in Hong Kong. Lectures on how self and peer assessment work were delivered via pre-recordings, students' presentations were recorded via real-time Zoom sessions, whereas marking rubrics, examples, and evaluation samples were shared via Moodle. From the students' English oral performances, evaluation forms generated in the self and peer assessment, as well as responses from students' interviews and the follow-up survey, it is indicated that with the introduction and incorporation of self and peer assessment via online platforms, most students became more conscious of their English presentation performances. Their learning motivation, self-awareness, confidence in making judgment, and speech making techniques were vastly improved in a short duration of three months.

While self-assessment was well-perceived as useful and constructive, respondents did express concerns regarding the validity and reliability of the evaluations conducted by their peer assessors. Doubts about objectivity and reliability of the student assessors still exist, particularly in the case of peer assessment. To keep confidentiality and avoid shame and anxiety, teachers may consider conducting peer assessment anonymously. With a double-blind review system, the white lie effect can be lessened too. On another note, the success of self and peer assessment depends

greatly on how experienced and mature the participants are. Rating errors may occur if the student assessors are novices. Teachers need to be cautious that self and peer assessment as part of the formal assessment shall affect students' GPA. Teachers need to ensure that all student assessors are given sufficient training and guidance before self and peer assessment are integrated in formal assessment.

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Online Teaching and Assessment Practices During COVID-19 Crisis: Perspectives from University Students



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Abstract In the academic year 2019/20, to ensure continuity of teaching and learning activities for students, Hong Kong universities largely moved their education online due to social unrest and then worldwide COVID-19 outbreak. **Research objective:** This study explored the student perspectives on online teaching and assessment practices during global COVID-19 crisis at a university in Hong Kong. **Methodology:** The good practices on online teaching and assessment were identified via qualitative analysis of the students' open-ended comments collected from the university's course-based evaluation with 8145 students involved near the end of Spring term of the academic year 2019/20. **Key results:** Six good practices on online teaching and assessment were identified. The findings provided useful insights for universities to review and reinforce their online education practices for the circumstances where in-person classes are rigorously limited.

Keywords Educational emergency · Higher education · Online learning · Student needs · Student learning experience · Course evaluation

1 Introduction

Starting from early 2020, the world has experienced an unprecedented public health emergency owing to the COVID-19 pandemic. To help control the spread of the coronavirus, various countries and regional areas temporarily suspended in-person classes in schools and universities as one of the precautionary measures in reducing the social contact among students and academic/administrative staff (Hussain et al., 2020). Universities had taken action to switch to online education so as to ensure continuity of teaching and learning activities and assessment for their students to study at home in the context of coronavirus crisis (Rahiem, 2020).

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In Hong Kong, the first confirmed COVID-19 case was found on January 22, 2020 (three days before public holidays of the Chinese New Year in Spring) and the University Response Team was immediately formed to help manage related matters and disseminate information to students and staff. In view of the pandemic situation in Hong Kong, physical presence on campus was subsequently not required for the whole Spring term for the university students. All classes were delivered using live interactive online mode on the scheduled timetable, and proctored online examination or alternative assessment were conducted. Therefore, students who were physically not on campus were still able to participate in and complete their classes and assessments online. Before the arrival of the pandemic, university classes in Hong Kong had been moved online few months earlier in November 2019 (Fall term of academic year 2019/20) due to the escalation of violence and confrontation throughout the society.

The transition to online university education had already been continued for a period of time. There were studies about the impact of the pandemic on academics, educational delivery, and higher education sector (e.g., Jung et al., 2021; Lin et al., 2020; Wong et al., 2020). But little was known on how students perceived and experienced online teaching and assessment practices at institutional level. Thus, the present study investigated the student perspectives on online teaching and assessment practices during COVID-19 crisis at a university in Hong Kong. The research question was: What kinds of online teaching and assessment practices do university students want and commend during the emergency situations like COVID-19 outbreak where physical presences of students on campus are rigorously limited? The good practices on online teaching and assessment were determined via qualitative analysis of the students' open-ended comments collected from the university's course-based evaluation. The findings of this study would act as useful reference for universities to strengthen their online teaching and assessment capacities to respond to future emergency situations where in-person classes are needed to be temporarily suspended, and to better administer the sudden transition to online education.

2 Literature Review

There were research studies conducted on the influence of the unprecedented pandemic on university teaching and learning in different countries and places, particularly in the early stage of sudden transition to online teaching and learning. Hussain et al. (2020) reported the experience of a national university in Qatar in responding to the suspension of classes under the pandemic. The university ensured continuity of teaching and learning activities and enriched students' learning experience by using available educational technologies of the university. Ismail et al. (2020) investigated the challenges and problems faced by Malaysia's university students when implementing online learning at the beginning of time that the world was shaken by the pandemic. They revealed that majority of the students were not ready for online teaching and learning approach primarily because of the low Internet connection which hindered the online learning.

After a period of conversion to online education, student comments on university teaching and learning were examined. Rahiem (2020) studied the experience of Indonesian university students after a month of emergency remote learning during the pandemic. Students had both positive and negative experiences of emergency remote learning that utilized blended strategies of e-learning, mobility learning, and conventional learning techniques. They enjoyed learning from home but technical barriers and resources hindered their learning. For example, students only used open access materials as libraries were closed and they did not have any access to paid online journals. Having been learning remotely for more than a month, students mentioned that they had some negative emotions such as feeling depressed, confused, devastated, and isolated. Cicha et al. (2021) explored Polish first-year undergraduate students' expectations about the education shift to distance learning under the second wave of pandemic situation in Poland. The study showed that students' feeling of pleasure in distance learning and sense of self-efficacy were the most important factors affecting the perceived usefulness rating and ease of use in the distance learning process.

The pandemic became a barrier preventing students from studying abroad. Based on the online study abroad experience of university students under the pandemic, Lewis and Markey (2021) suggested that future virtual study trips should incorporate more opportunities for student interaction (e.g., promote more student discussion) and explore online approximation of the informal interaction with local people. They found that a good study abroad experience relied heavily on student interaction with each other and with local people in the trip but these were not fully covered in the online format. Regarding the overseas study plans against the pandemic crisis, Mok et al. (2021) showed that the pandemic significantly decreased mobility of international students, and the management of pandemic and post-pandemic crisis became an additional consideration of the choices of destination for overseas learning. Thus, previous findings on the expectations and considerations of international students choosing a university before the pandemic crisis (Ng & Lee, 2020) may need to be updated in the future.

Comparing with other regional areas, due to social unrest, Hong Kong had transitioned to online teaching and learning mode a few months earlier before the arrival of pandemic. Lin et al. (2020) identified that teacher–student interactions played a major role in making a successful virtual classroom for Hong Kong university students. Ng et al. (2020) examined challenges on rapid conversion of university teaching and learning during the pandemic in Hong Kong. They found that students were concerned about the data privacy issue of web conference software and thus educating students' technology literacy (e.g., security and privacy settings) was crucial. For instructors, the results showed that there was a need of university support and professional training to equip them to become accustomed to online teaching. There were research studies about the online university education situation of Hong Kong for the period of pandemic. However, comprehensive studies about university students' perspectives on online teaching and assessment practices of the first and foremost semester without physical presence on campus were still limited.

3 Method

This study was conducted to investigate the perspectives of students at a university in Hong Kong on online teaching and assessment practices near the end of the first and foremost semester where physical presence on campus was not essential. A total of 13,728 students were invited to participate in the Student Feedback Questionnaire (SFQ) exercise Spring 2020 to provide feedback on the quality and effectiveness on their course learning experience. The students received an email invitation to complete an online SFQ survey for each of their enrolled course sections that were included in the exercise. Each survey generally was opened for 15 days, and an email reminder was sent to non-respondents of the survey on every three days. There were 8145 university students participating in the SFQ exercise, with a response rate of 59%; and a total of 1374 sections of courses were evaluated. The respondents were from different disciplines: business, engineering, science, humanities and social science, and interdisciplinary studies. The students' open-ended responses on the two open-ended questions "What is good about the course?" and "What could be done to improve the course?" which were about online teaching and assessment in the courses were extracted for further analysis in this study.

4 Results

There were a total of 827 open-ended responses related to online teaching and assessment out of the 8145 respondents. The content analysis approach was used to analyze the open-ended responses about online teaching and assessment in the courses. Each of the open-ended responses was examined and assigned with a code according to content and meaning. Similar codes were grouped together to delineate themes and sub-themes, providing six good practices on online teaching and assessment: (i) Effective usage of Zoom features and other teaching tools to facilitate real-time online classes, (ii) Adjustment of course design and lesson arrangement for adapting to online teaching, (iii) Willingness to answer students' questions during and after online classes, (iv) Well thought assessment arrangement for an online-teaching semester, (v) Actively seeking and responding to student feedback about online classes arrangement, and (vi) Sense of close relationship with instructors and peers during online classes.

4.1 Effective Usage of Zoom Features and Other Teaching Tools to Facilitate Real-Time Online Classes

In this study, 21% of responses were about effective usage of Zoom features and other teaching tools to facilitate online teaching. Students liked instructors who could use

the tools available in Zoom (e.g., “polling,” “chat room,” “raise hand”, and “breakout room”) properly to conduct classes so as to make classes more lively, interesting, and interactive. They added that the good use of some Zoom features could encourage students to answer questions and share ideas in classes more likely, and helped check the knowledge and understanding of students about the course content.

- *“Polling function could be used during lectures to check or recall the knowledge from students. Meanwhile, they can check their own understanding on certain topics or concepts.”*
- *“use poll function in Zoom if the course is online again so more students are more likely to answer the questions”*
- *“Did a good job in managing the class and breakout rooms”*
- *“Breakout groups were fun”*
- *“Professor encourages participation in the Zoom chat so more people are able to share ideas at the same time.”*
- *“As we use Zoom to have our lectures, it would be better if we can use the chat function in Zoom. We somehow don’t want to speak via mic, chat room would be a great alternative for us to answer questions.”*
- *“I think we can use more “raise hand” function of zoom to encourage students to answer questions/discuss to earn the participation marks”.*

Some students, as highlighted in the following comments, noted the appropriate usage of other digital tools and accessories such as iPad, screen highlighter, and screen pen, to facilitate real-time online classes teaching was necessary. This could let students read the writing notes and illustrations, and key points on the slides more clearly and easily so as to understand the contents of the lectures better.

- *“His standard of teaching was very high with online classes ... he used the iPad to draw graphs and write notes which was very clear.”*
- *“She writes in the iPad, which is effective for teaching under online mode. Piazza is a good website.”*
- *“He gave clear and attracting lecture as well as using smart tools like iPad for illustration in Zoom environment, which really helped us understand the content better.”*
- *“It would be great if prof can write or highlight on the screen.”*
- *” I think seeing the paper writing and the slide at the same time is kind of inconvenient. Maybe for online learning, some tools can be used to directly writing notes on the slide.”*

4.2 Adjustment of Course Design and Lesson Arrangement for Adapting to Online Teaching

Around one-third of the student responses (33%) were about adjustment of course design and lesson arrangement for adapting to online teaching. Students very much appreciated instructors who thoughtfully adjusted course design and structure to fit and accommodate the totally online teaching and learning environment:

- *“The course is very well designed and accommodated well to the sudden shift to an online environment.”*
- *“The course design also fits the online environment well, with online discussion forums and rich online resources.”*
- *“She very successfully creates an interesting and fine learning environment. She adapted the course structure very well for online teaching.”*
- *“The professor has designed the course really well. The mode of instruction has been well taken care off [sic] especially in this challenging condition of online classes.”*

Students indicated that they could be easily distracted in online classes. They emphasized the importance of offering short breaks during 3-h online lectures and playing course related games and interactive activities to help students concentrate in online lesson.

- *“Separating a three-hour session into three 1 h session helps student focus.”*
- *“Professor makes time for us to get some rest 3 times in the 3 h class. It is very helpful since online class could be distractive.”*
- *“3 h lecture ONLINE is way too long for me to keep up.”*
- *“I think the content is pretty interesting and the professor is doing a great job keeping our attention through the activities.”*
- *“It raises my awareness towards sustainability through different games and interactive activities. There were online simulation, role play, measuring our daily use of resource and online board game. They helped me concentrate in class. I love this new mode of teaching very much.”*

4.3 Willingness to Answer Students’ Questions During and After Online Classes

There were 16% of responses related to the willingness to answer students’ questions during and after online classes. It was vitally important for instructors to be responsive and ready to answer students’ questions efficiently and patiently during and after online classes as it was not possible for students and instructors to physically meet up on campus.

- *“A nice instructor. Patient to answer our question after class.”*

- *“The professor provided well-pitched level of lecture to us, and he was ready to answer our questions both during the class and outside of classroom.”*
- *“The instructor was always open to questions both in class and after class.”*
- *“The Professor is engaging, humorous and encourages students to ask questions in class or otherwise.”*

Students mentioned that the questioning and answering process could help make the online lectures more interactive. There was no need for students to be on campus during the pandemic crisis period. If students had any questions after online classes, they appreciated instructors who could be approachable through various medium such as email, Canvas Discussion, and Zoom chat room. Some instructors also provided additional Zoom classes/meeting hours where students could drop in to ask questions.

- *“He is more than eager to answer our questions in lessons, making the lectures very interactive despite it is an online lecture. I am happy that we can still maintain the quality of the lectures.”*
- *“She replies email quite quickly. She is patient while answering my questions.”*
- *“Very responsive to students through all medium e.g. chatroom on Zoom and emails.”*
- *“He also prepared extra office hours (2 days a week) where students could drop in on Zoom and ask questions.”*
- *“Professor gave additional Zoom class for questions.”*
- *“He is willing to hold zoom meetings for students to consult him one on one regarding lecture material.”*
- *“Professor lets us ask as many questions as we can in the Discussion on canvas.”*

One student reported: “Professor provided strong support to every student ... sending individual email to each of the student to ask how’s the progress in studying this course and if there are any difficulties, he mentioned a lot of times that he can provide help if we need.” The quote implied that showing care and support to students were crucial during the special learning situations.

4.4 Well Thought Assessment Arrangement for an Online-Teaching Semester

Twenty-two percent of student responses were about assessment arrangement for an online-teaching semester. For online education semester, students were very concerned about the trials of online examination setting for a course, prevention measures for avoiding student cheating, and fairness of the online examination. They reported that some instructors had conducted several trials of the online examination setting with students prior to the examination, so as to minimize worries due to changing the mode of examination from paper to online. Students also commended

that instructors made extra efforts on online examination question design to reduce student cheating.

- *“He did multiple trials for our exam from last semester, so he was well-versed in online exam. In addition, his exam questions were unique and challenging, so students didn’t have to worry about others cheating by looking up answers online or by colluding.”*
- *“With online teaching, the assessment method is not really good. As marks will only be given when the students get the right number. I think for this accounting course, steps and concepts are also important, and it becomes easier for student to cheat under the current practice.”*
- *“I think the setting of quizzes are very well for preventing cheating when compared to other courses, although I think there are still loopholes for cheating actually when the mode is changed to online.”*
- *“She tried her best to make online exams fair.”*

Suggestions on assessment arrangement were also made by students. They indicated that instructors should thoroughly consider whether a particular kind of assessment (e.g., field trip, groupwork) could be conducted smoothly after being moved to online mode, and also which kind of assessment was suitable for an escalating pandemic situation that students were recommended studying and staying at home.

- *“Field trip and field report assessment seem not suitable to be conducted via online teaching.”*
- *“Better avoid group project due to remote teaching. It is difficult for students to cooperate with each other under this situation.”*
- *“Too much groupwork in online setting is really challenging”*
- *“Professor also replaces the group project with individual simulation games, showing his understanding in regards to the online learning environment.”*

4.5 Actively Seeking and Responding to Student Feedback About Online Classes Arrangement

Some comments (12%) highlighted that instructors should actively seek student feedback on course setup to strive for better online teaching quality, well consider students’ opinion, and respond to students’ request no matter the proposed arrangement accepted or not.

- *“My favourite thing about the prof was that he was actively trying to improve by asking students which courses have good setups so he can observe.”*
- *“More than 1/5 of the students have asked to adjust the online exam in a way such that it is allowed to skip questions during the test, but the instructors are unwilling to listen. From their perspective, making it a question-by-question order is to prevent students from cheating. ... Professors should try to put themselves in our shoes and consider our situations, not going their own ways.”*

- *“I personally feel like instructors are a bit arrogant and just pretend they would listen to students’ opinions.”*
- *“Professor made up his schedule and responded to our request of holding extra workshops for the remaining topics.”*

4.6 Sense of Close Relationship with Instructors and Peers During Online Classes

The suspension of in-person classes was mainly used to reduce the social contact among students, academics, and staff. Some student responses (1.2%) expressed that a sense of close relationship with instructors and peers in online classes were still important under unprecedented pandemic circumstances. They liked having a chance to communicate with instructors, ask and answer questions, share their opinions and views with classmates, and listen to what their classmates said during online classes. They also appreciated those instructors who could think about different ways (e.g., call on student names, encourage students to turn their cameras on, and polling) to create an interactive atmosphere and keep all students engaged in class. Breakout room discussions (online real-time small group discussions) was certainly a good means for students to recognize their classmates and to interact with each other.

- *“Even though we had to move our classes online, Professor clearly thought about different ways he could keep us engaged. I think it is good when Professor calls on students, I believe it really does help keep students engaged.”*
- *“Allowing students to turn on their cameras will definitely encourage students to have active interaction with professor.”*
- *“I would like to suggest that if the instructor can interact more with students like providing some T/F [true/false] questions or polling for students to understand some concepts or calculation”*
- *“The instructor has created a good atmosphere which allows interaction between students as well as a lot of in-class discussions, even though the lesson was conducted through an online mode”*
- *“Many break out room discussions were organized during the course to provide a better understanding of various topics and also to give students a chance to communicate with one another and share their opinions and views on different issues”*
- *“I also appreciated that the breakout room groups were randomly generated every time because it allowed me a chance to get to know everyone in the class.”*

5 Discussion

This study examined the online teaching and assessment practice during the pandemic crisis based on the qualitative perspectives from university students in course evaluation. Results of this study suggested that appropriate online teaching platforms and tools, adjustment of course and lesson design and assessment arrangement, enhancing in-class interaction between instructors and students and among students themselves, being available after online classes for any questions and concerns, and maintaining good communication between instructors and students were all critical for online pandemic teaching.

Regarding the online teaching platforms and tools, this study revealed that effective integration of Zoom features to deliver real-time online classes is important. Polling, chat room, raise hand, and breakout room were the four common virtual interaction features that students highly recommended. The findings were supported by Moorhouse and Beaumont (2020) that teachers should familiarize with the video conferencing software like Zoom and utilize various features such as share screen, gallery view modes, microphone mute, and raise hand appropriately in virtual classes. Results of this study also showed that the use of additional digital tools and accessories (e.g., iPad, screen highlighter, and screen pen) as online teaching equipment were necessary for writing notes and illustrations purposes and highlighting key points on slides. To let students to have smooth online teaching and learning sessions, Ismail et al. (2020) also found that identification and selection of suitable learning tools for synchronous live teaching was one of the critical success factors for online pandemic learning.

A recent study by Rahiem (2020) indicated that most of the course syllabus was not designed for online teaching and learning. To accommodate the totally online teaching and learning environment during the pandemic, this study showed that appropriate course design and structure for adapting to emergency online teaching was indispensable. Extra efforts had also been made to help students concentrate in online classes, for example, offering mid-lesson breaks and playing course related games and interactive activities were useful. The findings were consistent with Ng et al. (2020) on online teaching practice for the period of pandemic crisis. Teachers needed to re-design their pedagogies to move teaching online and attempted to maintain students' learning motivation through a diversified mode of lesson activities, making online real-time learning active and interactive. Cheung (2021) also mentioned that pedagogies are required to be updated for better utilization of technology integration in online teaching.

There was no necessity for students to be on campus during the pandemic crisis and thus it was not possible for students and instructors to physically meet up on campus. Jung et al. (2021) indicated that what students learn in university comes from both in class and outside class such as talking with a teacher at the end of a lecture. This study found that, after transition to online teaching in the period of coronavirus outbreak, it was crucial for instructors to be responsive and ready to answer students' questions in online classes, and also be approachable after online

classes through digital channels such as email, Canvas Discussion, and Zoom Chat room and video meeting. For such online teaching and learning arrangement, Jung et al. (2021) also showed that some students felt comfortable to raise questions with their teachers using the chat protocol. Therefore, instructors should adopt the online communication tools pragmatically and appropriately to facilitate students' learning during and after online classes.

Examination and assessment design was also a concern for online education. To minimize student worries due to changing the mode of examination from paper to online, provision of trials of the online examination setting for a course were highly favorable. For example, instructors demonstrated and tested with students how to conduct an online proctored examination and solved any setup problems together. Preventive measures for avoiding cheating and fairness of the online examination were of students' focus and thus mitigation actions should be taken. Hussain et al. (2020) indicated that the university assessment strategy was revised to suit for online pandemic teaching. The issues of examination invigilation, integrity, and format were their major considerations while conducting online examinations with students outside of campus. This study also found that course assessment like field trip and groupwork should be planned and designed carefully before implementation in an online teaching environment under the unprecedented pandemic situation. After transitioning to online education, Lewis and Markey (2021) reflected that teachers were reluctant to assign group projects and assessments that required students to work together in groups for many hours, as students might not be capable to coordinate extensive groupwork remotely.

The suspension of in-person classes did not minimize the needs for the sense of close relationship with instructor and peers in online classes, according to the findings of this study. Enhancing virtual class interaction between instructors and students and among students themselves are necessary for online education. Lin et al. (2020) also revealed that teacher–student interactions played a dominant role in making the virtual classroom successful. In this study, students were fond of the online class atmosphere that gave them a chance to communicate with instructors and exchange their opinions and views with classmates. Encouraging students to turn their cameras on and creating breakout room discussion (online real-time small group discussion) are sample ways of keeping students engaged and interacted in class in this study. Rahiem (2020) showed that deep learning can be developed for students throughout synchronous peer discussion in online classes.

This study revealed that showing care and support to students were very important during the special learning situation and disruption of normal life due to the pandemic. Actively seeking and responding to student feedback about online class arrangement was a way to strive for better online teaching quality. Peachey (2017) showed that student feedbacks could help teachers to be aware of their online teaching performance, inspire and inform new teaching approaches, and take relevant improvement actions. For delivery of successful online learning, teachers needed to think judiciously on how to support and encourage students to learn and study.

Overall, the above-mentioned good practices on online teaching and assessment from the perspectives of students would assist universities in reviewing their current

digital education arrangement under unprecedented pandemic crisis. The findings would also facilitate universities enhancing the general quality of online teaching and learning when normal life is resumed. It was noted that there were limitations of this study. For example, demographics of the survey respondents were not collected and considered. The perspectives of online teaching and assessment practices may probably be varied in terms of full-time or part-time student status and age group of the respondents.

6 Conclusion

This study discussed the perspectives of university students on online teaching and assessment practices during unpredictable COVID-19 crisis in Hong Kong when in-person education and physical presence on campus were not recommended. The six good practices on online teaching and assessment were revealed from students' open-ended comments in the university's course-based evaluation. The identified good practices were (i) Effective usage of Zoom features and other teaching tools to facilitate real-time online classes, (ii) Adjustment of course design and lesson arrangement for adapting to online teaching, (iii) Willingness to answer students' questions during and after online classes, (iv) Well thought assessment arrangement for an online-teaching semester, (v) Actively seeking and responding to students' feedback on online classes arrangement, and (vi) Sense of close relationship among peers and between instructors and students during online classes. Results suggested that online teaching tools, appropriate lesson and assessment design, maintaining good communication between instructors and students, and enhancing in-class interaction between instructors and students and among students themselves have played vital roles in facilitating online learning under unprecedented public health situations. The findings of this study would be useful for universities to review their various aspects of online teaching and assessment so that administrators and instructors could smoothly and quickly implement and adopt the emergency digital education plan for students just in case. The findings would also be a reference for enhancing the quality of online learning design in general normal situation.

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Designing Inclusive and Diverse Artificial Intelligence (AI) Curriculum for K-12 Education



Thomas K. F. Chiu

Abstract The teaching of Artificial Intelligence (AI) topics in K-12 curricula is an important global strategic initiative in educating the next generation. Its education is new to schools and academia, and there is a serious lack of studies that informed school teachers about AI curriculum design. Inclusion and diversity within school education are primarily based on increasing the participation of underrepresented groups in learning. Curriculum refers to all experiences which are planned and guided by teachers. Teacher autonomy is crucial to the teacher's motivation and commitment to providing effective learning opportunities for students. Accordingly, this paper presented an AI curriculum that encourages teacher autonomy for school and examined whether the curriculum improves student perceived AI knowledge and relevance, and attitude and motivation toward AI, as well as caters students with different genders (i.e., girls vs. boys) and academic achievement (i.e., high vs. low) in learning AI. It involved 64 grades 8–9 students from a middle school. Results show that in the AI curriculum, (1) the students were perceived to be more competent, and developed more positive attitude and higher intrinsic motivation to learn AI, (2) there were insignificant differences between girl and boys, and (3) there were almost no significant differences between high and low achieving students.

Keywords AI education · Curriculum design · K-12 education · Inclusion · Diversity · Teacher autonomy

1 Introduction

The teaching of Artificial Intelligence (AI) topics in K-12 curricula is an important global strategic initiative in educating the next generation (Chiu et al., 2021; Pedró et al., 2019). As AI technologies are emerging and disrupting the status quo, and its education is new to schools and academia, there is a serious lack of studies that

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informed school teachers about AI curriculum design and development (Chiu & Chai, 2020; Pedró et al., 2019).

AI education goes beyond computational thinking. It explores how computers sense, perceive, make decisions, act, make sense of things, think, learn, and create (Chiu & Chai, 2020; Chiu et al., 2021). The first idea of teaching children AI was to explore AI through LOGO programming and the Turtle robot (Papert & Solomon, 1971), which is a learning activity, rather than a curriculum. To date, not many studies inform teachers to design AI formal K-12 curriculum (Chiu et al., 2021). These studies suggested crucial but fragmented findings in the research of AI K-12 curriculum development. For example, SenseTime collaborated with East China Normal University to publish the first textbook series for high schools—Fundamentals of Artificial Intelligence (SenseTime, 2018). The series focused on the technical content and skills and they were designed for student with higher learning abilities or stronger engineering background. Massachusetts Institute of Technology (Williams et al., 2019) examined different hand-on robot learning activities on kindergarten children learning and emphasized on student learning process. The use of robots in learning favored the boys. Accordingly, there is neither existing established AI K-12 curriculum designed for inclusion and diversity.

Inclusion and diversity within school education are primarily based on increasing the participation of underrepresented groups in learning (Chiu & Lim, 2020; Chiu & Mok, 2017; Chiu et al., 2020). In schools, most engineering-related curricula are conducted in after formal lessons outside classroom settings, and the majority of the participants are highly able and male students. However, UNESCO states that a quality curriculum should be designed in a fair and inclusive manner to enable all students to acquire and develop the knowledge, skills, and values, which leads to meaningful and productive lives (Stabback, 2016). Besides, inclusion and diversity are important to ensure the success of engineering education (Delaine et al., 2016; Ibe et al., 2018).

Curriculum refers to all experiences which are planned and guided by teachers, and learned by students whether it is carried out inside or outside classrooms (Kelly, 2009). It is also a description of what, why, how, and when students should learn. How the curriculum is perceived and organized influences the process of teaching and learning (Chiu & Chai, 2020; Kelly, 2009). Moreover, teacher autonomy, the capacity to take control of one's own teaching, can motivate student engagement (Chiu, 2021a, b, c; Chiu et al., 2021). Its role in curriculum is crucial to the teacher's motivation and commitment to providing effective learning opportunities for students (Chiu & Churchill, 2016; Chiu, 2017; Lennert da Silva et al., 2020). A curriculum that supports teacher autonomy is more likely to maximize the potential for the effective enhancement of learning by supporting student interests and needs (Lennert da Silva & Mølsted, 2020). Accordingly, this study investigated whether promoting teacher autonomy is able to design a more inclusive and diverse AI curriculum for K-12 students.

2 Literature Review and Background

2.1 Key Content for AI Education

AI key content knowledge that falls in the domain of engineering can be suggested and identified by engineering education studies. Accordingly, AI key content should (1) be interdisciplinary, (2) foster AI thinking and techniques, and (3) include AI impact and ethics (Chiu et al., 2021; Moore et al., 2014; Riskowski et al., 2009; Roehrig et al., 2012). Interdisciplinary: A well-designed AI curriculum at the K-12 level should emphasize its interdisciplinary nature to address the absence of interdisciplinary nature in well-established formal curriculum (Riskowski et al., 2009; Roehrig et al., 2012). For example, the curriculum should provide students with opportunities to apply developmentally appropriate mathematics in the context of solving AI problems. AI Impact and ethics: The curriculum should engage students in how AI impact our society. Students should be able to propose and create their solutions to the problems that impact life and society locally and globally, and also consider the possible ethical issues that could be raised. They have the responsibility to consider the safety and potential effect of the solutions on individual and public. AI thinking and techniques skills: Students should be empowered to believe that they can design and troubleshoot solutions to problems and develop new knowledge on their own. They are able to use informed judgment to make decisions for their solutions. Moreover, they should learn and implement various techniques, processes, and skills of AI technologies. Therefore, the curriculum should provide students with tools to build up their techniques and skills. However, these suggestions did not consider inclusion and diversity that are crucial to the success of engineering education. Can the key content cater to gender differences and students varied academic ability?

2.2 Inclusion and Diversity in School Engineering Education and Teacher Autonomy

Engineering education primarily is offered in post-secondary level and male students constitute the majority, which indicates that the students who receive engineering education are more likely to be highly able and male students in schools (Delaine et al., 2016; Ibe et al., 2018). Engineering education is thus less inclusive and diverse; the underrepresented group such as female and less able students may not receive engineering education. However, inclusion and diversity are very important for engineering education, particularly in K-12 settings. Catching student interest early on and then following through with that interest at K-12 level may be the key to inspiring more students, particularly for the underrepresented group, to pursue engineering or engineering-related study and/or careers (Delaine et al., 2016).

There has been recent growth in the availability of engineering-related learning activities at the school level; specifically, the popularity of Science, Technology, Engineering and Mathematics (STEM) rises in schools. However, without high quality curriculum design, these activities may simply mirror disparities observed at the postsecondary level (Delaine et al., 2016). Accordingly, school engineering-related learning and teaching, such as AI Education, offers a new trend in the educational pipeline that is in need of further research, particularly regarding inclusion and diversity.

Literature suggests that in schools, there are differences in personal attitudes toward engineering between the girls and boys, as well as between highly and less able students (Delaine et al., 2016; Roehrig et al., 2012). The studies found that the female and less able students hold less interest in, competence in, confidence in, and intrinsic value of engineering skills. One of the plausible reasons is that the students perceived the teaching and learning activities less inclusive (Ibe et al., 2018). They felt less supported and comfortable in the learning and teaching activities. For example, the use of robot in learning AI are not gender-neutral—favor boys; and heavy emphasis of coding activities may be too challenging for the less able students. Moreover, most engineering-related (e.g., AI) curricula are pull out and conducted in outside classrooms setting in K-12 schools. It is all too often the case that students are excluded on grounds of their socio-economic circumstances, gender, or academic ability.

Obviously, a good quality K-12 curriculum needs to be inclusive and diverse—to assist all students, regardless of socio-economic background, gender or academic ability, to develop their capabilities to the fullest (Stabback, 2016). Every child is different. Not all are academically gifted; some will do better in one field than in another; but all children should be supported and encouraged to achieve his or her potential. Therefore, a good quality AI curriculum for K-12 should make space for teachers to recognize each student personal and cognitive capacities, and to adapt the curriculum to suit the students in their classes (Chiu & Chai, 2020; Lennert da Silva & Mølsted, 2020). The curriculum should respect differences based on the ways how different children learn for their best, encourage learning differentiation, and provide teachers with the flexibility to ensure that their treatment of the content is appropriate to their student needs and capabilities. In other words, the curriculum should foster teacher autonomy in designing their own classroom activities/school-based curriculum in leading, assisting, and encouraging each student.

Teacher autonomy is an important aspect of the teaching profession (Chiu, 2021a, b, c) that is positively related to perceived self-efficacy and job satisfaction (Chiu, 2017; Chiu & Churchill, 2016; Wermke et al., 2019). These factors are crucial to teacher motivation, engagement, and commitment to fostering effective learning environments for students (Cribb & Gewirtz, 2007). This autonomy concerns the relations between teachers' scope of action and the curriculum' role in providing directions, resources and rules that constrain or extend the scope (Lennert da Silva & Mølsted, 2020). Accordingly, fostering teacher autonomy to design their class-based content and activities that can address the needs of varied abilities and gender differences is a major feature of good quality engineering school curriculum. However,

there is a lack of studies that investigated how to engender teacher autonomy in designing engineering curriculum for schools.

3 This Study and Research Design

3.1 Research Goal and Participants

As discussed, a K-12 AI curriculum consisting the key content and supporting teacher autonomy is more likely to offer a good quality AI education. It could increase student competence for, confidence in, and intrinsic value of AI skills, resulting in greater engagement. This paper presented an AI curriculum for Grade 7–9 students and examined whether the curriculum improves student attitude and motivation toward AI, as well as cater students with (1) different genders (i.e., girls vs. boys) and (2) different academic achievement performance (i.e., higher vs. lower) in learning AI. Accordingly, the three research questions (RQ) are

- RQ1 Would the curriculum significantly improve the student competence, attitude, and motivation toward AI?
- RQ2 Would there be any significant difference between boys and girls in perceived AI knowledge and relevance, and attitude, and motivation toward AI when learning with the curriculum?
- RQ3 Would there be any significant difference between high and low achieving students in perceived AI knowledge and relevance, and attitude, and motivation toward AI when learning with the curriculum?

To answer the three research questions, a purposeful sampling was used to select the participants for these studies. The criteria were student achievement and gender. Students' scores on computer sciences were used to reflect their achievement. And there were two teachers and the Grade 8–9 students (total: 64; 16 high achieving boys, 16 low achieving boys, 16 high achieving girls and 16 low achieving boys girls; aged from 13 to 16) from a Hong Kong middle school. The students have diverse socio-economic backgrounds and academic standards. Optimistically, such a curriculum could contribute to K-12 AI curriculum design, and bring large numbers of students, regardless their gender or ability, into contact with engineering, and enhance their interest and boost their confidence in the field. Hence, more students will be prepared to exploit opportunities in post-secondary education and the job markets in engineering-related disciplines in the longer term.

3.2 The Curriculum and Procedure

The curriculum used in this study is adopted by the studies of Chiu (2020). It used module-based and level-up approaches to create the curriculum framework. The framework is a 5-staged content approach of basic knowledge of, advanced knowledge of, process in, impact of, and ethics of AI, see Fig. 1. The design addresses the knowledge, competency, and ethical development. The curriculum comprises 8 topics: introduction, see, hear, speak, read, reasoning, impact, and ethics. The course materials for each topic comprised of theory learning, hands-on activities, and in-depth group discussions.

This curriculum design attempted to better support teacher autonomy. The module-based design is broad and comprehensive, which allows the teachers to select appropriate content and objectives. The level-up design caters to capacity building and it gives the teachers a clear path on how to develop student AI techniques and skills. Table 1 showed the model-based and level-up curriculum matrix. In each module, various case studies with different levels of complexity were created for the same task or discussion. Various tools with different technologies were created for hand-on activities. In other words, the teachers can pick the module and resources to cater their students’ interest and needs.

To start the research, we provided teacher participants with 2-week teacher professional workshops before their teaching. The teacher participants had no experience in teaching AI, and selected the topics, content, and activities to teach his/her students for 3 months, which aim to fit the students need and interest. In each teaching unit, different students may learn with different resources in different subtopics. The students completed 15-min pre- and post-questionnaires before and after the treatment.

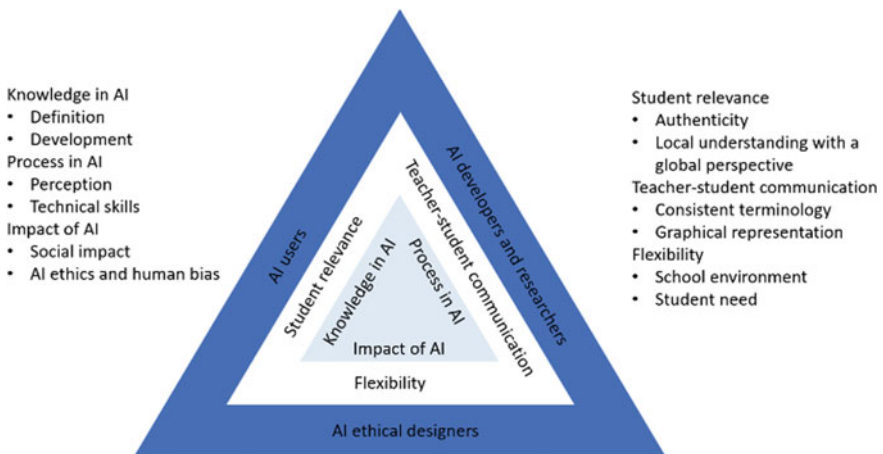


Fig. 1 Curriculum framework for K-12 AI (Chiu, 2020)

Table 1 Model-based and level-up curriculum matrix

Topics	Knowledge in AI		Process in AI		Impact of AI	
	Definition	Development	Perception	Technical skills	Social impact	ethics
Machine Learning						
See						
Speak						
Hear						
Reasoning						
Read						
Application						

3.3 Measures

Apart from demographic data, the questionnaire included 6 variables: Perceived AI knowledge (AIKG), AI Attitude (AIAT), AI relevance (AIRE), and Intrinsic motivation to learn AI (AIIM). Each of the variables adopted 5-point Likert scale items that were adapted from previous studies with acceptable reliability and validity (Chai et al., 2021; Chiu et al., 2021; Chiu & Mok, 2017). They are as follows:

Perceived AI knowledge (AIKG) measures student’s self-report of the level of basic knowledge they have for AI, with 3 items, and a sample item is “I have general knowledge about how AI are used today.”

AI Attitude (AIAT) measures students’ attitude toward learning AI with 3 items. A sample item is “I think learning AI is necessary.”

AI relevance (AIRE) measured students’ perception of the relevance of learning AI, with 3 items. A sample items is “The things that I am learning in this AI class will be useful for me.”

Intrinsic motivation to learn AI (AIIM) was adapted from the Motivated Strategies for Learning Questionnaire, with 3 items. A sample item is “I found learning AI fun.”

4 Results

4.1 Analysis Approach and Descriptive Statistics

Paired t-tests were adopted to answer RQ1; analyses of covariance (ANCOVA) were used to assess the differences in the post-questionnaire means after accounting for pre-questionnaire scores to answer RQ2 and RQ3. Table 2 presents the descriptive statistics for all variables. All variables met the assumption of homogeneity of variance, with all p values >0.05 in Levene’s tests.

Table 2 Descriptive statistics

Student (N = 64)				
Variables	Pre-questionnaire		Post-questionnaire	
	Mean	SD	Mean	SD
AIKG	2.82	0.51	4.11	0.55
AIAT	2.89	0.63	4.03	0.65
AIRE	2.82	0.61	4.03	0.69
AIIM	2.81	0.55	4.15	0.64

4.1.1 Research Question 1—Enhancement

The results of paired t-tests showed that the students significantly attained higher improvements in all the variables—AIKG, AIAT, AIRE and AIIM—with $t(63) = 17.37$ ($p < 0.001$), $t(63) = 18.89$ ($p < 0.001$), $t(63) = 19.02$ ($p < 0.001$), and $t(63) = 16.22.82$ ($p < 0.001$), respectively. Therefore, the curriculum effectively enhanced students' perceived AI knowledge and relevance, and attitude, and motivation toward AI.

4.1.2 Research Question 2 and 3—Inclusive and Diversity

The analysis of homogeneity of the regression coefficient showed that girls and boys had no significant difference in all the variables with all the p values >0.5 ; high and low achieving student groups had no difference neither. These confirm the assumptions of homogeneity. Following that, analyses of covariance (ANCOVAs) were conducted to analyze the scores in the post-questionnaires by excluding the effect of their pre-questionnaires scores.

In Table 3, the analyses showed that the boys and girls groups had no significant differences in perceived AIKG with $F(1, 61) = 0.05$, $p = 0.82$, AIAT with $F(1, 61) = 0.01$, $p = 0.91$, AIRE with $F(1, 61) = 1.38$, $p = 0.24$, and AIIM with $F(1, 61) = 0.39$, $p = 0.54$, of the post-questionnaire by using pre-questionnaire as covariate.

Other analyses showed that the high and low achieving students' groups had no significant differences in perceived AIKG with $F(1, 61) = 0.004$, $p = 0.95$, AIAT with $F(1, 61) = 1.95$, $p = 0.17$, AIRE with $F(1, 61) = 0.36$, $p = 0.86$, and AIIM with $F(1, 61) = 0.06$, $p = 0.81$, of the post-questionnaire by using pre-questionnaire as covariate, see Table 3.

It is concluded that the curriculum enhanced students' perceived AI knowledge and relevance, and attitude, and motivation toward AI. The implementation of the curriculum did not result in significant differences between boys and girls students on all dependent variables; the curriculum did not create significant differences between high and low achieving students on all dependent variables.

Table 3 Analyses of covariance

ANCOVA for RQ2 (N: girls = 32; boys = 32)					
Variable	Group	Mean	SD	F	P
AIKG	Girls	4.05	0.58	0.05	0.82
	Boys	4.22	0.55		
AIAT	Girls	3.90	0.66	0.01	0.91
	Boys	4.04	0.65		
AIRE	Girls	3.76	0.65	1.38	0.24
	Boys	4.03	0.69		
AIIM	Girls	4.03	0.68	0.39	0.54
	Boys	4.16	0.64		
ANCOVA for RQ3 (N: high achieving students = 32; low achieving students = 32)					
Variable	Group	Mean	SD	F	P
AIKG	High	4.13	0.47	0.0004	0.95
	Low	4.10	0.63		
AIAT	High	4.07	0.67	1.95	0.17
	Low	4.00	0.64		
AIRE	High	4.00	0.69	0.36	0.86
	Low	4.05	0.70		
AIIM	High	4.14	0.64	0.06	0.81
	Low	4.18	0.64		

5 Discussions

This study aimed to create a good quality AI school curriculum and examine whether it would enhance student AI learning, as well as would have the same effects on (1) girls and boys and (2) high and low achieving students. Consequently, this article presented three major findings.

The first finding is that the proposed curriculum had significant effects on enhancing perceived AI knowledge and relevance, and attitude, and motivation toward AI, see RQ1. This result supports those of related studies that suggest how to design K-12 engineering curriculum, such as those by Delaine et al. (2016), Moore et al. (2014), and Locke (2009), which indicate what key content in the curriculum should be included in effective AI or engineering curricula for schools. This finding further confirms that the curriculum design is appropriate for school students, and covers what students should master for AI technologies. The curriculum designs can foster students engineering thinking, techniques, and skills through different learning activities such as case studies, hand-on activities, and discussion.

Second, the curriculum equally benefited both the boys and girls on fostering perceived AI knowledge and relevance, and attitude, and motivation toward AI—(AIIM), see RQ2. The curriculum advocates teacher autonomy-supportive, rather than controlling strategies, which allows for choices around planning, and reduces unnecessary stress and demands on teachers. This is aligned with the studies from

Chiu and Chai (2020), Chiu (2020, 2021a, b), and Rogers et al. (2010). The school teachers should consider student perspectives, make their own choices and decisions with regard to the curriculum based on their student preferences and interests. This approach would encourage and facilitate students to support their endorsement of classroom behaviors (Assor et al., 2002). Autonomy allows teachers to have more room to choose their teaching goals, which might result in more effective teaching.

Finally, the results for RQ3 show that the curriculum equally benefited both the high and low achieving student groups on enhancing perceived AI knowledge and relevance, and attitude, and motivation toward AI. The results align with studies of school-based curriculum such as Marulcu and Barnett (2016) and Chiu and Mok (2017), and Chiu and colleagues (2020). Supporting teacher autonomy will encourage them to select resources that fit the student academic ability (Chiu & Chai, 2020); hence the teaching is more likely to intrinsically motivate students to cognitively engage in AI learning. It is essential to build student efficacy and competence through tailored made lessons. As they are more engaged, they are likely to gain more confident, feel more relevant and intrinsically motivative themselves to pursue further AI learning. Educationally, this is the type of experiences that teachers need to offer to their student through the curriculum design activities.

Accordingly, the curriculum design can delimit the problem space of the curriculum creation, which guide the teachers on what and when to teach. Creating inclusive and diverse engineering curriculum should take teacher autonomy into consideration. It is because the curriculum design advocates teacher autonomy, and teachers are encouraged personalized student learning by satisfying the student innate needs—autonomy (having choices in own learning), competence (feeling capable of learning AI), and relatedness (being connected to the AI content and learning) (Chiu, 2021a, b, c; Chiu et al., 2021).

6 Limitations and Future Research

Four limitations in this study are noted here. First, while this study appears to support the effects of teacher autonomy on student perceived competence, attitude, and intrinsic motivation, more studies are needed to validate the findings. The results could be extended by additional studies on computational thinking related to AI technology, students' learning approaches for AI, and AI anxiety. Second, the findings indicated that there were almost no significant differences between high and low achieving students, and further studies should revise to examine how different curriculum designs facility teacher autonomy. Third, this study did not consider how teachers select learning resources in the curriculum, and future research is suggested to investigate the subjective experiences of how teachers select the resources to address inclusion and diversity. The final limitation is that the teaching was conducted during COVID-19 period, and so the full effects of the curriculum may not have been revealed, and future studies should adopt longitudinal research design.

The major conclusion of this paper is that applying key content and teacher autonomy in creating K-12 AI curriculum would benefit varied academic ability and gender students. Student participants in this paper reported that they felt more competent, confident, relevant, motivation when learning AI with the materials in the curriculum. It was because the curriculum is able to satisfy the student innate needs—autonomy, competence, and relatedness (2021a, b).

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Creativity and Social Media

The Need of Having Journalistic Creativity in Journalism Education: A Review of the Literature on Media Creativity and Look Beyond



Wendy Wing Lam Chan

Abstract The research about journalism has been dominated by a discourse of *media professionalism* and a myriad of research shed light on how it affects the industry's development, and at the same time, *political ideology, career pursuit, and personal desire* have also been playing a crucial role in affecting the news industry. The success of both traditional and online journalism is often measured by the degree of creativity in presenting the fact; however, a lack of focus on creativity is brought into the media education. This paper critically examines the notion of *journalistic creativity* in relations to the twenty-first century development of journalism. The research aims are twofold: First, to investigate what are the antecedents mentioned in the prior research that drive the news industry to achieve creativity. Second, the paper points to the limited discussion of journalistic creativity in the academia and suggests there are underlying antecedents for new media and traditional creativity: political environment, journalists' motivations, media professionalism and company's support and resources, etc. which might explain why journalism needs creativity in this day and age, and thus media creativity should be brought into media education in the near future.

Keywords Creativity · Journalism · Media creativity · Media education · Media professionalism · New media

1 Introduction

When people ask about creativity, usually a number of questions follow: what creativity is; where creativity is observed; and if it pertains to the creative industry or cultural sector. Often, researchers are interested in the interdisciplinary nature of creativity; hence it is eruditely discussed in the field of psychology as much as it matters in the literary and performance arts, such as dramaturgy, folkloristics, ethnomusicology, linguistic anthropology, among others (Farman, 2015; Malmelin &

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49

Virta, 2016; Sawyer, 1998). As described by Csikszentmihalyi (1996), “creativity is some sort of mental activity, an insight that occurs inside the heads of some special people” (p. 23) with “components” such as domain, field, and knowledge. Furthermore, it involves certain sensibilities:

without a good dose of curiosity, wonder and interest in what things are like and in how they work, it is difficult to recognize an interesting problem. Openness to experience, a fluid attention that constantly processes events in the environment, is a great advantage for recognizing potential novelty (Csikszentmihalyi, 1996, p. 53).

Hence, perception plays an important role in the recognition and shaping of creativity. For Robson and Stockwell (2005), the ability to perceive things from a wide range of viewpoints is key; what is common can be presented as astonishing and new, when a fresh perspective is introduced. Creativity, therefore, in the field of journalism is anything but new. What makes the subject of creativity unique in this particular field is the manner by which journalists become creative; it arises from how the sensitive political environment alongside their strict adherence to media professionalism stimulates not only their constant curiosity but also their sensibilities and perceptions. This is becoming more and more apparent in the contemporary era of fast-paced media and technological advances pressing journalists to fight for their survival.

Moreover, while various existing works talk about creativity, this study will only focus on the context of journalism; hence the study becomes much narrower but not necessarily simpler or less complex. Hence, the present discussion aims to offer a critical discussion on what the potential factors that contribute to the notion of journalistic creativity are, and how they shall be emphasized in the media education.

2 Theoretical Foundation for Journalistic Creativity

2.1 Theoretical Foundation: Csikszentmihalyi’s System Model of Creativity

A wealth of studies view creativity as an abstract concept, something that could almost only be sensed but hardly explained. Fields relevant to this present study include the literary arts, sciences, social sciences, media education, languages, and psychology (Mohan, 2011; Noppe & Gallagher, 1977; Zhou & Shalley, 2007; Amabile, 1996; Stenberg & Lubart, 1996). Common discussions are concerned with western and eastern perspectives of creativity, in which the western creative tradition emphasizes more on novelty and originality of the thinking process; whereas, the eastern creative tradition considers the more pervasive role of aesthetics, goodness, and authenticity (Kharkhurin, 2014). Related to the said perspectives is the notion that creative individuals must be romantic, free from constraints in order to practice creativity (Boden, 2004). Yet, this is not realistic in day-to-day journalism practice, considering how rational professionals practically work in a well-structured domain,

where constraints are often encountered. Therefore, this acts as impetus for research to look into journalistic creativity. While constraints are often found in the typical journalistic working environment, it does not necessarily mean that creativity could not take place as such.

When a creative individual pursues “a novel solution to a presented problem,” it could significantly change the domain from where the problem arises (Csikszentmihalyi, 1996, p. 97), hence knowledge is shaped. Thus, in the real world, if individuals do not possess the knowledge, they could barely be creative. Hence, it is first imperative that they are well-equipped with a good knowledge of the domain. Along the same line, an analogy can be made for creative mathematician for not being able to contribute anything new if the community in which he/she lives does not process the past knowledge (Sawyer et al., 2003). Simply put, knowledge about the domain and the individual’s creative performance is, therefore, interrelated.

On the other hand, Csikszentmihalyi (1996) also suggests that for creativity to take place, there must be a system, a structured body of knowledge, and an individual working within this system. Journalism is not exempt from this scenario. Csikszentmihalyi (2014) further explains that the said model represents three crucial elements: culture, society, and personal background. The first element, culture, is directly linked to learned rules controlling the human consciousness, such as thoughts, emotions, and beliefs. Furthermore, Csikszentmihalyi (1996) breaks culture down into domains; each having a set of rules and practices that share more or less the same characteristics. Therefore, individuals can only be creative if they are permitted to access the knowledge of a domain. Along the same line, Fulton (2011b) conducted research that applied the systematic model of creativity put forward by Csikszentmihalyi (see Fig. 1).

She interviewed a number of experienced journalists to identify the antecedents of the creative process in journalism practice. One interviewee, a reporter, responded that “although journalists need to act within these expectations, this is not to suggest these structures are totally deterministic. It is important to remember that within these

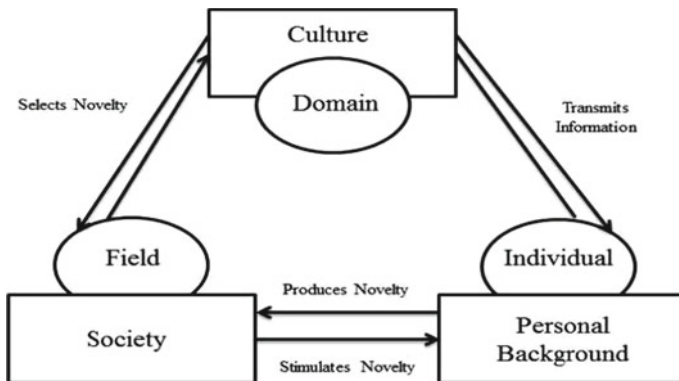


Fig. 1 The system model of creativity (Csikszentmihalyi, 1999, p. 315)

structures a journalist has agency and can use expectations to enable their action and generate work that is both novel and appropriate, thus producing a creative text.” (Fulton, 2011b, p. 8). Thus, the model tells us that creativity takes place in the domain of journalism, and more than that, it also highlights the relationship between the individual, the field, and the culture.

In summary, understanding creativity as it is understood by journalists could never directly lead to the understanding of creativity in the field. Apparently, there are more factors leading to this phenomenon. Journalists’ creative ideas, factors arising from the environment, to name a few, could correspond to what Csikszentmihalyi (1999) termed as “individual,” “culture,” and “field” (p. 315). The following section will explain further how this model lends itself to journalism. Moreover, other existing studies that used similar system models of creativity are discussed.

2.2 Creative Process: Relevance to Journalism

Discussing how the creative process works is as important as the components of creativity itself. Looking at the creative process can shed light on essential factors, such as the difference between group work and individual work, and how the former fosters creativity in different ways as compared to the latter, especially in problem solving. In White’s argument (1968), the creative process or creative thinking is not a peculiar type of thinking. Explicated further by Csikszentmihalyi (1996), the “creative process starts with a sense that there is a puzzle somewhere, or a task to be accomplished. Perhaps something is not right, somewhere there is a conflict, a tension, a need to be satisfied. The problematic issue can be triggered by a personal experience, by a lack of fit in the symbolic system, by the stimulation of colleagues, or by public needs” (1996, p. 95). Thereby, the creative process commonly takes place at the working environment. When putting it into a journalistic context, journalists often find problems, which they in turn respond to by introducing creative solutions. When seen at the organizational level, it can be argued that individual acts of creativity can be added up to account for the creativity of a group or team (Runco, 1997). This idea is supported by literature that highlight how creativity is a positive result of group work (Farmer et al., 2003; Malmelin & Virta, 2014). This is especially true for journalists who, while initiating the stories themselves, collaborate with their editors throughout the process.

Therefore, one may ask how one comes up with creative solutions when they encounter problems. There is ample evidence showing that to be creative is both an ability and a process. According to Sternberg and Lubart (1991), to be creative has two main aspects, “first the ability to define and re-define the problems; and the ability to think insightfully” (p. 609). However, mere ability only lays the ground for creativity to grow. Flow theory, as proposed by Csikszentmihalyi (1996), emphasizes that typically individuals feel most engrossed in an activity when coming up with something new, thus highlighting that creativity is a process. In addition, when individuals are wholly engaged in an activity, often their greatest reward is when

they display the highest degree of responsibility (Gardner et al., 2002). Working out a problem and discovering solutions therefore demonstrate that creativity can be a learning process; hence learning environments are also fertile grounds for cultivating creativity. Prior studies often put forward the idea that the creative process is instigated when “one is faced with a problem, one suspends judgment and generates new possibilities by the use of disruptive elements in which one thinks creatively, and finally, one reinstitutes judgment and evaluates the products thus produced” (Bailin, 1988, p. 67).

Furthermore, Csikszentmihalyi (1996, p. 79) explained that creativity can take 5 steps, ranging from preparation (becoming immersed in a set of problematic issues that are interesting and arouse curiosity); incubation (during which ideas churn and approach the threshold of consciousness); insight (sometimes called the “Aha!” moment); evaluation (when a person must decide whether an insight is valuable and worth pursuing); to elaboration (that takes up the most time and involves the hardest work). In comparison, Wallas (1926) also talked about *the art of thought*, and suggested that knowledge is the first step, followed by incubation, then illumination, and ultimately, testing the feasibility. Both step-by-step scenarios actually fit the working routines of day-to-day journalism at large. They both offer hints for us to dig out the important factors that may trigger the creative process.

In the journalism field, routine is often seen as a restriction for creativity to take place. However, this is not the case. As can be observed, every journalist generally takes a deep consideration of what they need to report—this process does not only entail mere thought but also include problem-solving. For instance, journalists often weigh the code of ethics against the political stance of their newspaper, while keeping in mind how they must professionally keep their job. At the same time, they must also try to report accurate and relatively neutral content to their audiences or readers. As the *Flow theory* suggests, when journalists engross themselves in the work, it indicates that creativity is coming into play.

The twofold creative process is experienced in day-to-day journalism. The first is when the journalists address the problems, and the environment allows them to do so, thereby possibly adopting innovative approaches given that they have time to enhance their work. However, if the environment is not as compatible, the journalists have to play the edge ball, which is to offer creative solutions to solve the problems. This is especially true when they have to comply with the rules, while presenting the truth to the general public. Thus, creativity comes into play when there is a problem. Hence, the problems that this study intends to highlight are the two major aspects: political ideology and media professionalism. These lend journalism its own creative process that differentiates it from others.

2.3 Creativity’s Criteria: Relevance to Journalism

Originality and *novelty* are used to be understood as the key concepts for creativity, as “original products must be unanticipated and unpredicted” (Bailin, 1988, p. 13),

while “people are considered to be creative if they produce ideas that are different from those of others” (Kharkhurin, 2014, p. 341). However, other scholars go as far as proposing four main contributing factors to creativity: *fluency*, *flexibility*, *originality*, and *elaboration* (Baer, 2014; Guilford, 1967), and these may be observed in different disciplines. Still, others propose that *originality* and *usefulness* are the main definitive characteristics of creativity while others suggest *novelty* and *appropriateness to the task or problem being addressed* (Sternberg, 1999). Thus, it can be surmised that mere talent is not enough (Sawyer et al., 2003), as other factors contribute to creativity—including a fresh perspective or even luck. Thus, while many scholars have already attempted to put forward ways of explaining creativity, a clear definition hardly comes up.

Hence, it does not come as a surprise why journalistic creativity still needs proper academic attention. The mere fact that this ability or process is perceived can lead us to pertinent questions: What is the creativity in journalism? Why does the media industry crave for journalistic creativity? What kinds of difficult situations and dilemmas do media practitioners encounter in order for creativity to take place? (Table 1).

Table 1 Summary of the creativity’s criteria and the corresponding descriptions

Creativity in different disciplines	Descriptions
(Bailin, 1988)	<i>Key concepts for creativity: novelty and originality</i>
(Boden, 2004)	<i>Creative people have to be romantic: free from any constraints in order to practice creativity</i>
(Csikszentmihalyi, 1996)	<i>Creative: a novel solution to a presented problem could change the domain in significant ways Creativity: the person’s strong resolve to do what must be done; the existing field, a structured body of knowledge and an individual working within the system</i>
(Fulton, 2011a, b)	<i>Creativity in journalism: journalists have agency and can use expectations to enable their actions and generate work that is both novel and appropriate, thus producing a creative text</i>
(Kharkhurin, 2014)	<i>Western creative tradition: novelty and originality in the thinking process Eastern creative tradition: aesthetics, goodness, and authenticity</i>
(Robson & Stockwell, 2005)	<i>Creativity: the ability to perceive things from a wide range of viewpoints, in contrast to common expressions and the one who receives the message would feel astonished</i>
(Runco, 1997)	<i>Creativity: individual part of creativity is added up to a team of creativity</i>
(Sternberg & Lubart, 1991)	<i>Creativity: the ability to define and redefine problems, and the ability to think insightfully are relevant to creativity</i>
(Sawyer et al., 2003)	<i>Creativity needs past knowledge or otherwise, provides no opportunities to do state-of-the-art work</i>

In summary, creativity can be understood as an ability to solve problems. As a process, it requires various criteria, which may be summed into four: *novelty*, *originality*, *usefulness*, and *appropriateness to the task or problem being addressed* (Amabile, 1996; Kharkhurin, 2014). These key criteria apply in the context of journalism in terms of finding novel solutions and original stories that provide the audience with fresh perspectives, and coming up with useful ways of addressing existing problems. Journalists do these while adopting appropriate ways of communicating with the general public.

Often, journalists find themselves trapped in between media professionalism and political ideology, the two important aspects previously mentioned. Creative headlines and a wide range of figures of speech, such as the use of sarcasm, could often be employed to keep the audiences' minds stimulated, occasionally surprising them.

3 Journalistic Creativity

While this study recognizes the variety of studies that shed light on journalistic creativity, here they are divided into three parts, namely *journalists' nature*, *journalists' environment*, and *journalists' options for creativity*, in order to offer a complete picture of creativity that is highly related to journalism. Despite the professional nature of journalists in giving factual information to their readers, mirroring others' individual experiences, acting as witnesses, and representing the media, they find joy and satisfaction throughout the process as it opens more opportunities for creativity (Fulton, 2015; Guo, 2014). For instance, Ma and Yuen (2008) observed how and argued that students enjoy using wikis to write the news because they find the joy in newswriting. It's as if journalists are born to crave for knowledge, and to enjoy digging out the truth and creating innovative stories that capture their audience. Hence, creativity in journalism is tightly associated with the nature of the journalists' job. Markham (2012) believed that hinging the idea on the relationship between creative ideas and journalism is meaningful as journalists enjoy the dynamism of their routines and the increased interaction with their readers. Fulton (2015) also surmised that reporters have been trained to understand the nature of their job, and what they should do for the public, such that in her discussion on the role of reporters, her interviewee (a reporter for Mumbrella, a media and marketing site) explained that.

most of what we do, we would apply the rules of journalism, as we see it, to them. So for instance, you know, we'll when we do anything, whether it's an event, whether it is a news story, we'll try and be very transparent with the readers, write for the readers, not for the advertisers (p. 371).

Thus, it can be well understood that reporters do not only execute their job for the sake of being paid their salary but also take the initiative to bring new angles and excitement into the stories. After all, "journalists are subjected nearly every day to pressures that challenge and test their profession" (Gardner et al., 2002, p. 185). It

is also important to note that media practitioners want to produce “good work,” and with this aspiration, they tend to consider novel ideas which generally pertain to good work that “happens inside the head of engaged professionals” (Gardner et al., 2002, p. 13). In this manner, journalists approach creativity as an intellectual inventiveness and a way to conjure up some kind of novelty that could likewise be applied by others (Berglez, 2011; Gilhooly, 1988). Journalists do this to avoid predictability and pandering, while maintaining accuracy as a standard as their differing ideas bring them into competition with each other (Gardner et al., 2002, p. 156). In short, journalists tend to become creative in their efforts to improve their work and make their reports appealing to their audiences and readers.

In summary, journalists aim to produce good work in the field, and their creative ideas transpire in their heads. They find meaning in their very professions as journalists, which is an important reason why they are motivated to perform their jobs. This is what scholars in the abovementioned literature talk about; the aspiration that drives journalists could have something to do with the interaction between them and the readers or their inborn nature to find the truth and speak for the society. In light of these factors, they are keen on producing novel ideas that fall within the standards—the code of media ethics.

3.1 Journalists’ Environment

Journalists are becoming well aware of the fact that new technological devices or computer techniques could help enhance their work—to look better, and more attractive or distinctive—however, in the school’s environment there is seemingly restriction in terms of content and context, let alone the journalistic environment (Guo, 2009). In the journalistic environment, reporters see creativity as the key factor for the betterment of their career path. According to Curran (2010), lifelong learning, innovation, and creativity are the crucial factors that lead to journalism’s success in the foreseeable future. Also, Fulton and McIntyre (2013) mentioned that “when a journalist learns, uses and interacts with the structure of journalism, that is, the rules, conventions, techniques, guides and procedures of the domain of journalism, these enable the production of a novel and appropriate text” (p. 23). Thus, journalism, in fact, could serve as a good breeding ground of creativity. When we talk about creative journalism, people commonly associated it with feature writing rather than hard news (Maskell & Perry, 1999; Ricketson, 2004). As previous studies of creativity have shown, authors generally agreed that creative activity could be found and explained in different forms within the domain of journalism (Berglez, 2011; Fulton & McIntyre, 2013; Markham, 2012; Mohan, 2011). Furthermore, it has been stated that creative thinking is a skill that is highly prized in editorial news, journalism, advertising, and copywriting (Moriarty & Vandenberg, 1984). In this manner, researchers who have been looking for excellence in producing “good work” have put forward their views toward the subject of creativity.

To summarize, the journalism industry seems to maintain a set of rules or conventions. Scholars, however, made keen observations about how the interaction between the domain of journalism and the techniques and conventions of journalism practice serve as means to produce novelty. Regardless whether we are looking at hard or soft news, feature writing, advertorials, et cetera, the creativity that comes out of the process is generally highly prized in all sorts of media-related work.

3.2 Journalists' Opt for Creativity

Journalists have an urge for good work, and this good work is always associated with the term “novel text.” Csikszentmihalyi (1996) even posited that the level of creativity produced is closely related to the character of individuals in the field, those “who seemed to be doing things that they enjoyed but were not rewarded for with money or fame” (p. 110). In other words, the very nature of journalists—the way they enjoy their role in producing creative work—influences the outcome of their novel texts.

Often, the nature of creative writers can be regarded as comparable to that of journalists. However, there are fundamental differences between the two groups, especially in terms of their nature, for example, credibility found in new media use (Shen et al., 2011). Kaufman (2002) argued the same in that.

“Creative writers such as novelists, poets, and, to a lesser extent, playwrights may be introverted or avoid social encounters; their success or failure depends on a product that may be created with little outside input. Journalists, in contrast, must thrive on such interactions, as much of their work typically involves gathering information and opinions from other people” (p. 202).

Still, Markham (2012) asserted that creativity in journalism has in effect shed light on expressiveness, thus reflecting what can be considered a broader cultural shift from demonstrating professional expertise to emphasizing personal authenticity in their means of expression. In addition, he made mention of how journalism is now becoming more and more creative, as evidently reflected by distinct practices and forms of outputs. By breaking the existing limits of media logic, journalistic creativity could create more room for more interesting pieces of reports (Berglez, 2011). Often, media practitioners put this concept of creativity into practice. In a study of interpersonal communication and creativity in journalistic telework, Manssour (2003) contended that “creativity is mostly seen as a gift or an individual quality, for those whose bloom and exercise there are internal and external factors, understood as stimulants of the creative process” (p. 41). In short, journalistic creativity depends largely on both internal and external factors—this will be discussed in later sections.

Creativity has been brought under the spotlight in this day and age (Amabile, 1996; Chan, 2017a, b, 2018, 2020; Gardner et al., 2002). In the media environment, individuals need to express their work in a way that those who are not working in the same field have ever attempted. In the news reporting and editorial process, practitioners encounter a lot of internal and external factors; factors such as the

political environment within the newsroom, the selection of content, the choosing of news angles, as well as the code of ethics are considered as internal factors, while the loyal readers' expectations, advertisers' demands, society's political pressures, as well as market shares, and so on, come as external factors. Journalists often find themselves caught in between these different pressures while they constantly having a crack at outstanding headlines and wonderful stories. In short, journalistic creativity—as in any other form of creativity—and the niche skills that come with it can only be learned from firsthand day-to-day practice of journalism (Table 2).

4 Theoretical and Empirical Studies of Journalistic Creativity

Within this huge research area lays a small niche for the researcher to look at creativity in the competitive journalism environment. Berglez (2011) posited that journalistic creativity is knitted with practices of extending and/or breaking the existing limits of media logic. For instance, the practice and skill of sniffing out new and exciting topics does not only bring about new creative information but also help stimulate the market and make news organizations commercially sustainable. As the media logic lies in between two extremes—the scientific point of view and stylistic creative presentation—Berglez (2011) propounded that in order to change the journalism industry, one has to think beyond the boundaries of the media logic. Thus, thinking and going beyond entails journalistic creativity, with its three major types as already mentioned: firstly, to search for ways to insert an issue, i.e., climate, into the media logic; secondly, to find ways to stay scientific in climate reporting; and lastly, to find ways to transform the media logic in accordance with the all-encompassing and transcendent features of the climate issue.

Fulton's (2011a) research also demonstrated that social influences are significant in the production of creative texts—by investigating how print journalists in Australia produce their work. As her discussion followed Csikszentmihalyi's creativity model, she pointed out that the field is a crucial element in the creative production of news texts, as it reflects how the social system understands the domain (field) as well as every individual involved in the system. Thus, what is presented is the complete opposite of the romantic notion of the individual as the focal point of creativity; the creative work is not constrained by an individual reporters' skill, as it is also a product of the interaction of the reporter with the editor, and so on. Therefore, in a journalistic environment, the journalist's interaction with the field proves "a vital component for creative outcome" (Fulton, 2011b, p. 10).

In connection with the above research, Fulton and McIntyre (2013), in another piece about journalistic creativity, contended that there is a creative process in the journalists' discussion. Notwithstanding the form of writing in journalism, it is seldom thought of as a "creative practice" (p. 17). Further, in print journalism, a rather traditional media, some practical rules are repeatedly emphasized, such as

Table 2 Summary of the concept of journalistic creativity and the corresponding descriptions

Journalists' nature	Descriptions
(Berglez, 2011; Gilhooly, 1988)	<i>Journalists found creativity as an intellectual inventiveness and a way to conjure up some kind of novelty that could be applied by others</i>
(Fulton, 2015)	<i>Reporters have been trained to understand the nature of their job, and what they should do for the public</i>
(Gardner et al., 2002)	<i>Media practitioners want to produce good work, and with this aspiration, they generate novel ideas in their head</i>
(Markham, 2012)	<i>Journalists enjoy the dynamism provided by their routines and by increased interaction with their readers</i>
Journalists' environment	
(Curran, 2010)	<i>Journalism's success in the foreseeable future: lifelong learning, innovation, and creativity</i>
(Csikszentmihalyi, 1996)	<i>Creativity in journalism: characteristics of the individuals in the field, the enjoyment that creativity brought them, to do things that they enjoyed regardless whether or not they are rewarded with money or fame</i>
(Fulton & McIntyre, 2013)	<i>Journalists interact with the structure: the rules, conventions, techniques, guides, and procedures of the domain of journalism enable the production of novel and appropriate texts</i>
(Berglez, 2011; Fulton & McIntyre, 2013; Markham, 2012; Mohan, 2011)	<i>Creative activity can be found and explained in different forms within the domain of journalism</i>
(Maskell & Perry, 1999; Ricketson, 2004)	<i>Creative journalism: people commonly associate it with feature writing rather than hard news</i>
(Moriarty & Vandenbergh, 1984)	<i>Creative thinking is a skill that is highly prized in editorial news, journalism, advertising, and copywriting</i>
Journalists' opt for creativity	
(Berglez, 2011)	<i>Journalistic creativity: breaking the existing limits of media logic creates more room for more interesting pieces of reports</i>
(Kaufman, 2002)	<i>Creative writers and journalists have different goals and creative processes; journalists must thrive on social interactions, as most of their work typically involves gathering information and opinions from other people</i>
(Manssour, 2003)	<i>A study of interpersonal communication and creativity in journalistic telework: creativity is mostly seen as a gift or an individual quality, for those whose bloom and exercise there are internal and external factors, and understood as stimulants of the creative process</i>

(continued)

Table 2 (continued)

Journalists' nature	Descriptions
(Markham, 2012)	<i>Creativity in journalism: emphasizes expressiveness and reflects a broader cultural shift from professional expertise to heighten the emphasis of authenticity of the personal expression</i>

styles, ethics, news values, and ideological conventions. However, journalists in Australia interacted with social, cultural, and individual influences in the production of the work—these learned social and cultural structures enable journalists to appropriately apply creativity in their work, with the aim of capturing the audiences' eyes and holding their attention until the end of the story. As mentioned by one of the interviewees (reporter) in Fulton and McIntyre's research, stories like feature news can use a sort of more "flairy" language. Other means include how a journalist approaches the story, such as "thinking out of the box," while putting the story together given a whole lot of information.

Kharkhurin (2014) argued that there is "creativity 4-in-1," wherein, there are altogether 4 criteria in constructing creativity, that could be well applied in broader disciplines. The attributes include novelty, utility, aesthetics, and authenticity. Novelty is defined as bringing something new into the being by introducing new conceptual framework. Utility, on the other hand, means that the creative worker himself is a creative one, or that he has the ability to produce anything that can be considered creative. Aesthetics refers to the fundamental truth of nature, while authenticity is an expression of the inner self's true self and values. Malmelin and Virta (2014), on the other hand, built on the notion of creativity in the journalism industry. Their research identified the most significant motivations and constraints of creative work. These motivations or work rest on two important criteria, developing new personal competencies and skills, and creating new things, practices, and processes. On the other hand, the constraints on creative work include project management and organizing of the team, and communication and information management. And, journalism professionals "were particularly keen to improve and develop their own work, for instance by innovating new ways of content production" (p. 7). Manssour (2003) found that creativity is generally seen as gift or an individual quality, and there are internal and external factors that act as stimulants for the creative process. Regarding their focal point of the discussion, these highlight the crucial role of interpersonal communication among the workers and act as incentive to individual creativity. His idea, therefore, supports the need for creativity in the journalism industry.

In relation to journalistic creativity, Markham (2012) suggested that in the domain modes of valorization, there is apparently a broader cultural shift from professional expertise to the authenticity of individual expression. There is a tight relationship between creativity and journalism. As emphasized in his argument, "creativity is valued because it represents a form of agency" (p. 195). Furthermore, he believed that creativity benefits the journalists, the organization, and the audience. In addition,

Kaufman (2002) showed that creative writers score more significantly than journalists on narrative thoughts, yet there is interaction occurring on their paradigmatic thought. In light of this, narrative thinking style helps differentiate between the writers and journalists. Male journalists and male creative writers would go for a sentence writing task in different ways, and female journalists and female creative writers may not differ in performing the same task. Hence, there is an apparent difference between males and females in terms of handling the creative work but we could not deny the fact that the journalists form all types practice journalistic creativity thought there is discrepancy between the gender (Table 3).

All in all, people working for this industry hardly gain the space for journalistic creativity. It is said that “newswriting performance might be improved by employing individuals with high creative aptitudes and providing sufficient time intervals for them to rest between writing tasks” (Lynch & Kays, 1967, p. 512). In this manner, Malmelin & Virta (2015) also contended that the duality and resulting time pressures made it difficult for the workers to focus on the work of the development team and on developing novel ideas. Hence, due to the abovementioned constraints, creativity has only a rather stifling environment to take its place. However, on the flip side, this study would like to argue that it is the constraints that help muster the creativity within the domain because reporters try their best to get around the ban and produce the “good work.” In summary, there have been different interpretations of journalistic creativity in the field of research. However, despite the flourishing phenomenon of journalistic creativity in the industry, there still are apparently more constraints for the development of journalistic creativity.

5 Look Beyond to Future Journalistic Education

5.1 Media Creativity to Be Included in the Future Curriculum

Media Creativity shall be one of the antecedents introduced from prior researchers’ perspectives, while they (Loveless & Williamson, 2013) highlighted the fact that the future of learning, curriculum, and pedagogy will affect the shaping of learner identities. In the new era of new media coming into place, creativity should not be absent from the current curriculum so that the young reporters could catch the pulse of the society. Recent research has pointed out that media creativity has triple implications, in which it is a concept that (Witschge et al., 2019) highlights the fact that it is a guide for journalists and young journalism students for the available research methods, what shall be included when studying journalism, and also it serves as the inspiration for carrying out research. Not only journalistic and media creativity becomes a need for the industry, the journalism students also enjoy a great deal from the creativity found from media journalism and media industry, and thus they will have motivation. Prior research also supported this observation, and it is said that the

Table 3 Summary of selected theoretical and empirical studies of journalistic creativity

Studies	Findings
(Berglez, 2011)	<p>(1) <i>The reproduction of media logic</i></p> <p>(2) <i>Underlying desires to rub media logic the wrong way from a research horizon (creativity from outside the media logic)</i></p> <p>(3) <i>Ideas about, and concrete implementation of, new types of reporting (creativity from beyond media logic)</i></p>
(2011b; Fulton, 2011a)	<p>(1) <i>Productive activity (producing an article): members of the field such as senior staff, other journalists, and the audience support a journalist's creativity by providing a source for articles</i></p> <p>(2) <i>There are interactions between editors and reporters. It is from the editors that they learnt how to write</i></p> <p>(3) <i>Journalist's interaction with the field is a vital component for a creative outcome</i></p>
(Fulton & McIntyre, 2013)	<p>(1) <i>Journalist is indeed a creative producer</i></p> <p>(2) <i>Journalists understand rules, as well as procedures of the domain, that creativity occurs when the novel and appropriate texts produced</i></p> <p>(3) <i>Creativity is encouraged in the workplace, employers expect journalists to produce, or create, work efficiently</i></p>
(Kaufman, 2002)	<p>(1) <i>Creative writers scored significantly higher than journalists on narrative thoughts</i></p> <p>(2) <i>Male journalists significantly outscored male creative writers, a non-significant trend in the opposition direction was observed for females</i></p>
(Kharkhurin, 2014)	<p>(1) <i>Four-dimensional matrix for evaluation of creative work: novelty, utility, aesthetics, and authenticity</i></p>
(Malmelin & Virta, 2015)	<p>(1) <i>Developing new personal competencies and skills is a hugely important factor in the work of journalism professionals in the media organization</i></p> <p>(2) <i>Journalism professionals were particularly keen to improve and develop their own work, for instance, by innovating new ways of content production</i></p>
(Manssour, 2003)	<p>(1) <i>Communication at work's atmosphere; necessity of conviviality (a necessary way to exchange ideas and to reveal emotions, to discuss subjects of work or daily life)</i></p> <p>(2) <i>Evaluation includes behaviors, via the importance of interpersonal communication, it helps achieve communication and creativity</i></p>
(Markham, 2012)	<p>(1) <i>Relevance of creativity in journalistic practice is to be seen in context of a broader cultural shift in dominant forms of authority from expertise to authentic</i></p> <p>(2) <i>Creativity is valued because it represents an agent</i></p>

students are in hope for a rather dynamic lifestyles and also opportunities to express their creativity (Hanusch et al., 2016). The journalism students, when they applied for their journalism program, indeed have an expectation of reaching out to the world, especially in search of good, innovative, and insightful stories. And, because of this inner nature of being professional journalists, thereby, creativity is, to a large extent, a crucial component of the curriculum that the students long awaited.

5.2 How Media Creativity Shall Be Taught in the Class

But one question, though, is how media creativity shall be taught? Concerning the journalism education, Deuze (2006) suggested in his research on global journalism education that journalism shall not be disconnected from community since journalistic stories, in his opinions, must be framed in tight relationship with journalism and society. Different methods, for instance, content analysis, and case studies to expert interviews would not be singled out and shall not stand on its own. The mission of the program and the curriculum should be considered but not limited to it. Mensing (2010), along the same line, put forward the need of rethinking the future of journalism education, and that the community-centered focus could offer a way to reconstitute journalism to match journalism beyond the university. On the other hand, Coffee (2011) has explained in her research that creativity is actually a rational process which could be reflected from hard work and also the interaction of systems and structures. The creative practices in journalism were highlighted in different arena of the journalism practice, including the cultural producers' practice. Maiden et al., (2020) talked about their observation about how digital technologies could better enhance the creative outputs in media context. They agreed the fact that new computational analyses could present the materials in a novel way, and hence considered creative. Thereby, it is believed in the upcoming development of journalism education, more emphasis could be put on technology, platform usage, creative thoughts development, and also how to improvise ideas in the conforming and conflictual environment. This has to be an ability to be developed by the students and the journalism classes.

6 Conclusion

To sum up, this paper proposes that based on the prior literature, in order to uncover the complexity of the issue of journalistic creativity, one should not miss out the role of journalistic creativity that played inside the mechanism of journalistic work. Conforming and conflictual environment are the catalyst for creativity to be developed in this industry. Further attention on this matter is needed to understand how creativity formed, in what shape it is in the real practice, and ultimately look at how creativity benefits the industry in the near future. It is high time we focused on finding

more antecedents that constitute media creativity. And at the same time, it is believed that in the near future, teachers teaching journalism shall look closely on how they could enhance students' creativity in the lectures.

(Note This is an extension and revision of the Author's Ph.D. thesis chapter and prior conference presentation presented in the NCA 104th Annual Convention, but it has never been published at any journal, conference proceeding, and book chapter).

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Social Experiential Learning for Zero Waste Education in a Liberal Arts University



Paulina Pui Yun Wong  and Gary Wai Chung Wong 

Abstract Critical thinking and problem-solving are recognized as key twenty-first century skills, but their development requires some fundamental shifts in pedagogy. Rapid technological advancements have allowed widespread use of communication tools and platforms, such as social networks, allowing users across the globe to exchange knowledge. Such collective sharing leads to spontaneous peer-to-peer collaboration which is crucial for sustainable social development and addressing societal challenges. However, educational pedagogies have not adapted to maximize the potential of such network effects for social learning, as prior studies examining the benefits of these technologies for learning show limited student engagement and distraction. To examine these findings further, in the present study, semester-long video logging activity related to zero-waste of 32 students attending a liberal arts university in Hong Kong was analyzed. Participants uploaded videos using a purpose-built mobile application Soqql, which is similar to commonly used social media platforms, as it allows content sharing, as well as commenting on others' contributions. At the end of the semester, time spent by students viewing peer videos were compared to scores it received from an independent rater. A simple linear regression shows that students who viewed their peers' contributions for longer periods scored higher, with an average increase of 12.3% based on average minutes viewed per student. The R^2 (0.276) and existence of heteroscedasticity suggest that more unknown factors are at play. Nonetheless, these results point to the benefits of learning from others, indicating that educational platforms can help students improve self-regulation, thus enhancing their critical thinking and collaboration skills, which are essential for twenty-first-century pedagogy.

Keywords Social learning · Sustainable social development · Education for sustainability · Experiential learning · Video-based learning environments

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1 Literature

As educational pedagogy shifts from traditional classroom settings to digital environments, learners must develop the requisite skills such as collaboration and creative thinking (Egan et al., 2017; Hunaidah et al., 2018). This transition requires close engagement with peers to bring about diverse views and co-create solutions (Teo, 2019). As higher order thinking skills are increasingly recognized as one of the key educational goals, it is crucial to understand how students communicate with each other.

Owing to rapid technological advancements, young generations now primarily communicate via online platforms, especially social networks, which allow users to exchange information about their daily activities. Consequently, social networks are conduits of social learning (Bandura et al., 1966), as users learn by observing and emulating others. Given the growing popularity of this peer-to-peer knowledge exchange method, it is important to examine the value of online environments for educational purposes.

As youths regularly post videos of their activities and share their opinions on Facebook and TikTok, the educational potential of these activities should be analyzed. Social learning, for which the theory is the main framework in this study, can increase collaboration, creativity, and confidence (Kang et al., 2015). From the educational perspective, open and spontaneous content sharing is more engaging than traditional educational assessments like essays or quizzes. Thus, it can be assumed that this highly sociable mode of communication would promote information seeking and enhance student learning (Yoon et al., 2021). However, despite evidence of positive student attitudes toward blogging (Tajuddin et al., 2012) and benefits of social media in knowledge acquisition (Arulogun et al., 2020; Goodyear & Armour, 2021; Jomezai et al., 2021; Kolhar et al., 2021; Purvis et al., 2020), research on the effects of video watching is lacking.

Some authors argue that open sharing of materials among peers contributes to collective intelligence, which is developed when a group of agents work collaboratively to solve a problem (Reia et al., 2019). Collective intelligence is also described (Cross, 2014) as group intellect that is developed when people work together by sharing and collectively solving problems. Studies on collective sharing environments, as a means of promoting collective intelligence, have demonstrated positive learning outcomes, suggesting that collective sharing can encourage idea generation and content consumption due to peer influence (Samantray & Riccaboni, 2020). Lord et al. (2017) similarly found that the consumption of self-reflection content in a collective sharing environment increased academic performance of their study participants. These findings have motivated the present investigation, as social media are an ideal tool for information exchange, thereby encouraging students to collectively share ideas to produce best practices for waste reduction techniques. However, not all social learning networks encourage meaningful discussion (Doleck et al., 2021), and may thus be of limited value in the educational context (Hollis & Was, 2016). Nonetheless, as experiential learning techniques (Kolb, 1984) have been proven effective in

a wide range of educational domains, it can be assumed that these methods could help boost knowledge building through observation of and reflection on peer content (Falloon, 2019). As collective sharing environments, such as social networks, have rarely been examined through this lens, further studies in this domain are clearly needed.

According to Luna-Nemecio et al. (2020), collaboration and critical thinking skills are prerequisites for the development of collective intelligence and sustainable social development. Therefore, to ensure that online platforms can be used by collaborative communities to improve coexistence, quality of life, inclusion, equity, and psychological well-being, among other benefits, they have to be appropriately designed. For example, Arocena and Sutz (2021) are of view that sustainable development requires innovations in education that specifically foster development of collective knowledge. In an earlier study, Indrianti (2016) similarly found that collective sharing environments focusing on waste elimination are effective in enhancing participants' sense of environmental awareness and responsibility toward their community.

This investigation thus aims to look into a student-generated video-based approach and social learning method that allows for the learning of waste reduction methods in a novel manner. To determine the learning benefits of this method, student engagement can be measured by the duration of peer-to-peer video views, and compared to overall learning performance. In line with these aims, two research questions are addressed:

- To what extent does the duration of students' peer-to-peer views of peers contribute to the quality of overall videos' scores?
- What is the perceived student utility of social learning through video activities in sustainability education, specifically in waste reduction?

2 Method

This study adopted an explanatory mixed method approach to examine the impact of video-based social learning for students in sustainability education. The primary goal of the analysis was to determine if increasing students' watching of peer videos can increase students' video scores. Potential reasons for the correlation was then described by students in post-course reflective essays.

2.1 *Participants and Methodology*

The study sample consisted of 32 undergraduate students pursuing a liberal arts degree at a Hong Kong Liberal Arts University. They were instructed to create two videos to monitor their weekly waste production. Students were asked to upload their videos on a purpose-built mobile social learning application Soqqle (<https://soqqle.com>), which also allows for exchange of feedback (likes and comments). Students were given one week to produce each video. The duration of each video was also

instructed to be kept within 5 min. Thus, the two video activities were completed over a period of two weeks. Also, the participants were also instructed to leave comments on each other’s videos for idea exchange.

Soqqlle was selected as the platform for this study due to its familiarity with popular social networks like Tiktok and Facebook. Besides features commonly seen in social apps like user-generated videos and comments, Soqqlle also allows teachers to give private feedback. Teachers were also able to view consolidated student content (videos and comments) on a web dashboard. Finally, the application enforces privacy as students must unlock a passcode created by the teacher to access Soqqlle. The application is also used by thousands of students every semester across different educational institutions in Asia. Overall, it is anticipated that the video-based student-generated content on Soqqlle will help students to better co-create ideas and share content more collectively.

It is also worth noting that prior studies (Akcaoglu & Lee, 2018; de Lima et al., 2019) on social networks for learning had reported low participation for some students. According to Akcaoglu and Lee (2018), a lack of relevance, utility, and personal interest (with regards to social networks) contributes to participation issues. With the use of student-generated videos, it is hoped that the format would achieve more learning goals, create more utility on learning, and thus inspire more participation. Also, as Soqqlle is a purpose-built social learning environment, its relevance for student learning is expected to be higher, thus inviting more interest. The use of Soqqlle learning dashboards may also better support the teacher in evaluating higher volumes of video content. Timely feedback from the teacher may also create more learning utility. Finally, while student-generated videos had been studied previously (Peterson et al., 2020), its application in a social learning environment, such as social networks, is lesser studied. The ability for Soqqlle to achieve scalability to volume will also be one of the points of discussion in this study.

The tasks provided for students to complete were designed using Kolb’s experiential learning framework (Fig. 1), which postulates that peer-to-peer information exchange promotes individual and collective knowledge attainment (Konak et al., 2014; Orús et al., 2016). Therefore, it was assumed that the same process could

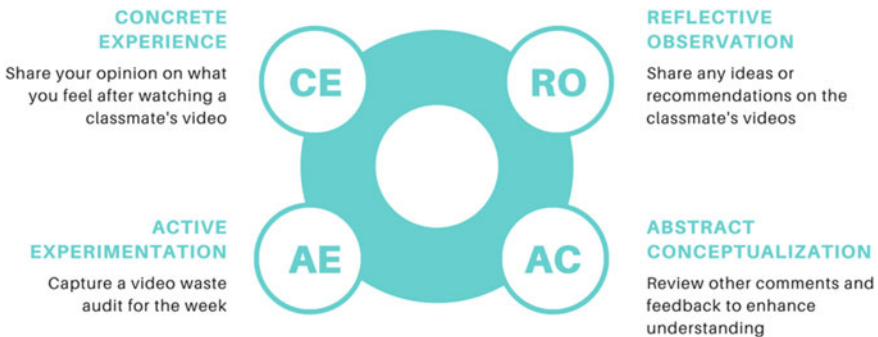


Fig. 1 Experiential learning model for the waste audit module

encourage mutual cooperation, awareness, and accountability (Indrianti, 2016) with the aim of enhancing community-based zero-waste management efforts. Participating students were given limited instructions on the activity, but were shown several videos previously produced by other students as a guidance.

To facilitate peer-to-peer information sharing, students were asked to upload their videos on a purpose-built mobile social learning application Soqqlle (<https://soqqlle.com>), which also allows for exchange of feedback (likes and comments). To ensure that the application is used solely for the purpose of this study, students were given specific class codes and were only allowed access to the content related to the waste audit module.

2.2 Data Collection

For the purpose of data collection and analysis, Soqqlle captured the amount of time each video was played on the mobile application if more than 7 s. Comments keyed in by students were also captured. The authors were able to download the data in a spreadsheet (in csv format) from a web analytics dashboard.

To help further to explain student motivation in this video-based waste audit process, students were asked at the end of the semester to write a reflective essay. Quotes that reflected the student’s learning outcomes in the context of observations of peers will be selected for analysis.

2.3 Data Analysis

At the end of the semester, two independent raters scored student videos using a custom criterion (Table 1). The videos were rated according to the quality of content, the depth of analysis, the effort placed on the video as well as the presentation

Table 1 Criterion for rating waste auditing videos

Criterion	Description	Weightage
Content	The level in which task met module requirements in auditing the daily waste (e.g., Show the measures of calculating amount of plastic, food waste)	0.25
Depth	The amount of consideration placed in sustainability concepts when completing the tasks	0.25
Effort	The amount of effort placed in completing the tasks (e.g., Taking the additional steps to review and correct actions)	0.25
Presentation	The level for which the presentation was able to reflect the tasks conducted for auditing. (e.g., Showing summary tables, actual actions of recycling)	0.25

outcomes. The two raters were selected based on their prior backgrounds and experience in zero-waste projects. Prior to being selected, the raters were given trial tests to evaluate and validate their knowledge in zero-waste. Key points like the usage of single use bottles, bamboo flosses, compostable garbage bags as well as the extent of the segregation of waste for recycling were taken into consideration. The two raters also went through a reconciliation process post-rating to align evaluation expectations and mismatches. The average of video scores from both raters were then used for data analysis.

In order to derive an average improvement based on students' video watching, a simple linear regression analysis was conducted to produce a correlation co-efficient that can predict an improvement to overall video scores, the dependent variable (Table 1) based on the time participants spent on watching videos produced by peers, the independent variable. To further support the potential impact of peer video views to scores, quotes from the student essays submitted at the end of the semester were shared. Finally, certain parameters, such as average video length and percentage of views across the entire population, were analyzed.

Prior to data analysis, inter-rater reliability was measured by the percentage method by taking the sum of all differences in ratings across all videos and then dividing by number of videos. To support the validity of the percentage differences, a Pearson's correlation was used to detect the extent of disagreement across the two raters (de Raadt et al., 2021), if any. A Cronbach's alpha reliability test was also conducted on all the video scores (by the four categories) to check reliability. The tests and analysis (Pearson's correlation, Cronbach's alpha, and simple linear regression) were executed using JASP (<https://jasp-stats.org/>).

To control the independent variable (duration of peer video views), the following strategies were followed: (i) students were given the same amount of time (1 week) to produce a video; (ii) students all used the same mobile application Soqql for watching videos; (iii) students lived in Hong Kong and are expected to have satisfactory Internet connections.

3 Results

Analysis revealed that, collectively, 32 participants recorded 62 waste audit videos (Fig. 2), which contained a variety of features, including summary tables, voiceovers, and categorizations. In addition, 29 students provided a total of 139 comments (Fig. 3), with an average length of 20 words.

Prior to data analysis, any self-views where the students were watching their own videos were eliminated. Two independent raters subsequently rated the videos based on the provided categories (Table 1). Videos that showed little effort in sorting or categorizing, had little creativity, with poor presentations were generally scored below 3 (out of 5). While videos that were comprehensive, with explanations of waste reduction concepts and summaries scored more than 3 (out of 5). Considerations were also made based on whether students improved on their daily waste reduction.

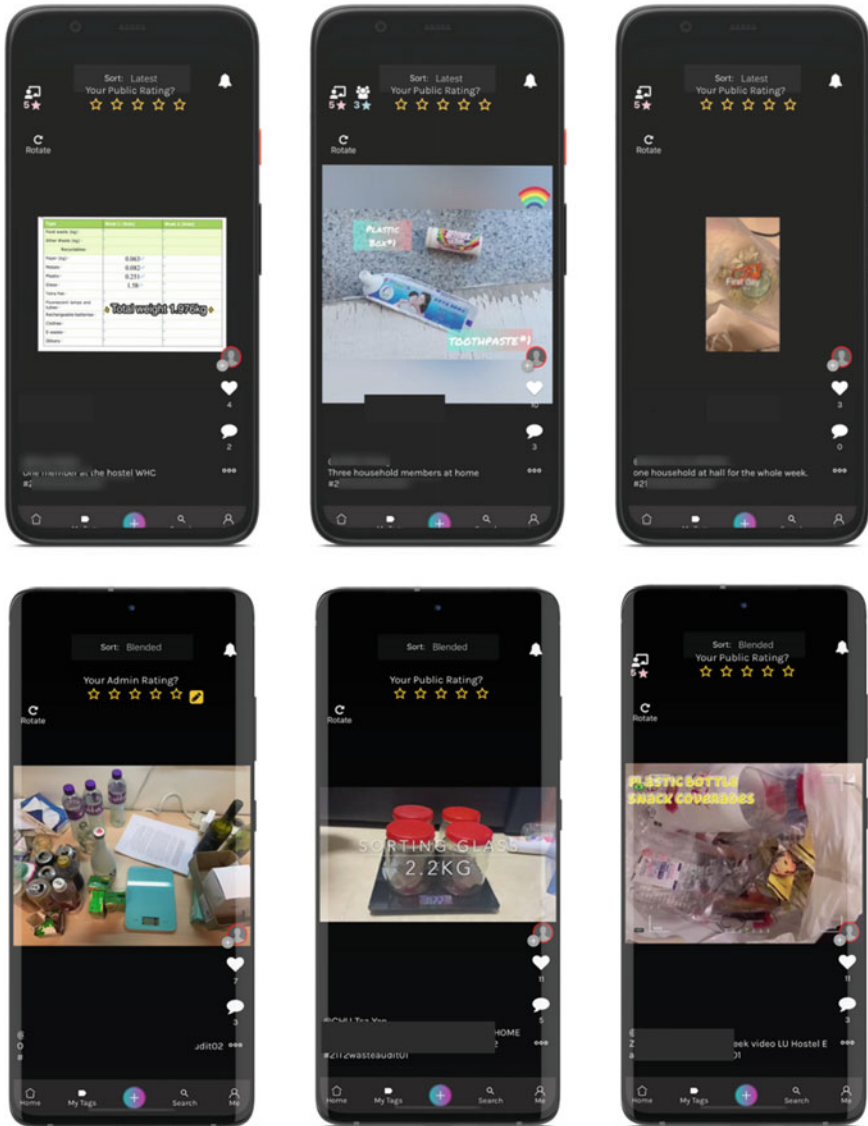


Fig. 2 Screenshots of videos captured during the waste audit project

A reliability test on the ratings yielded an overall Cronbach Alpha score of 0.987. Cronbach’s alpha of each of the categories was as follows: method, 0.980; depth, 0.983; presentation, 0.985; and effort, 0.981. As the scores of the categories were designed (25% weightage each for a total of 100%) to make up a total score, they were combined to a single overall score as the dependent variable. This is also supported by the high multicollinearity seen in the Cronbach Alpha score.

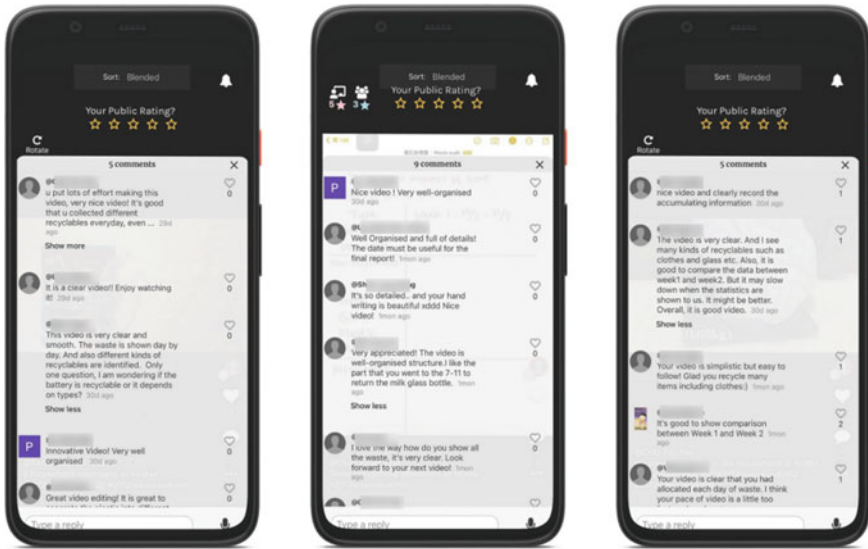


Fig. 3 Screenshots of comments captured during the waste audit project

Comparing the difference of ratings between the two raters, they differed by 2.95 points (over a total possible, 20 points, five points for each of the four categories) on average per video. This comes to an overall 85% inter-rater rating, calculated based on $1 - (2.95/20)$. In addition, Pearson's correlation of the ratings from the two raters shows a high correlation ($R = 0.957$, $p = 0.001$).

A normality of residuals was examined through normal Q-Q Plot (Appendix C) which was even and uniform. A simple linear regression (Appendix A) was used to predict video scores (dependent variable) based on the time spent watching videos (independent variable) submitted by peers. A significant regression equation was found ($F(1, 60) = 22.896$, $p \leq 0.001$), with an R^2 of 0.276, suggesting that participants' predicted video score (SCORE) is equal to $14.832 + 0.087(\text{MIN})$, where MIN is measured per minute of viewing videos of peers and SCORE is the overall rating of the video. Participant's video score increased 0.087 for every minute of peer-to-peer video view. The minutes of peer-to-peer video view is a significant predictor of total video score.

To determine an average improvement across the group, the mean number of minutes per student (28.323) was applied on the regression equation. As a result, the average improvement per student is 12.3% (i.e., $28.323 * 0.087$ divided by a total possible score of 20). A Durbin-Watson test indicates a 0.363 auto-correlation which suggests that the same participant's video performance is linked and might potentially be consistently affected by the social learning environment. It should, however, be noted that heteroscedasticity was seen (Appendix D), which indicated larger variances for videos with lower overall scores.

As can be seen from Appendix B, scores pertaining to presentation and effort were most affected by time spent on watching videos posted by peers (0.477 and 0.490). It is particularly noteworthy that most participants reduced plastic bag and straw use, and ordered fewer takeaways. They also improved the presentation output through the use of summary tables, better voiceovers, and clearer explanations related to waste sorting, recycling, and cleaning. Improvements were also noted in video speed, recycling of clothes and bags, sorting, and eating habits. Similar views were shared by other participants, as indicated below:

... I have known that there are a few recycling stores in Hong Kong by watching classmates' videos. In the stores, there are many kinds of classification of waste, and the stores are developed by the Environmental Protection Department. Although there is no recycling store in my community, I know more about recycling and the techniques made by the government to attract people to recycling.—Participant A

Through watching classmates' household waste audit videos, I learnt a lot about green practices from my classmates. For example, red pockets can be reused as bookmark and wired containers. What surprised me the most is the advantages of invisible bag. Compared to general plastic bags, invisible bags are non-toxic and harmless during dissolve process, which are more environmental-friendly. I think that invisible bags can be widely used in retailing stores like clothing stores and bookstores so as to reduce the amount of insoluble plastic bags. All in all, thanks to the two weeks of home waste audit project, I can know how much waste was produced in my home.—Participant B

Participants also highlighted that the comments from peers directly contributed to improving the quality of their videos, as explained by our participants:

In the first week, I sorted the things according to my personal understanding, found the corresponding recyclable locations for recycling, and then took a video and uploaded it to the platform. After that, I received suggestions from my classmates and made some improvements in the second week. In the second week, I tore off the wrapping paper on the plastic bottles, threw away the caps, and put the plastic bottles in the recycling bin.—Participant C

After uploading my first week's recording video, I received comments from my classmates. The comment said I threw away the trash without removing the tape from the carton, which is not good for recycling. So in the second week, I corrected that. The recyclables are removed from the packaging and washed before being put in the bin.—Participant D

3.1 Participants and Topic

The study sample consisted of 32 undergraduate students pursuing a liberal arts degree at the Hong Kong Liberal Arts University. On two occasions, they were instructed to create videos and leave comments on each other's videos on the topic of waste audit, which involved monitoring their weekly waste production. The tasks were designed using Kolb's experiential learning framework (Fig. 1) whereby it's potential peer-to-peer learning benefits (Konak et al., 2014; Orús et al., 2016) could encourage mutual cooperation, awareness, and accountability (Indrianti, 2016) to support community-based zero-waste management. Participating students were

given limited instructions on the activity, but were shown several videos previously produced by other students as a guidance.

4 Discussion

Even though viewing videos produced by their peers was not compulsory, the 32 student participants on average watched 28.323 min of videos posted by others. Therefore, we posit that the experiential social learning model was successful in encouraging establishment of a collective sharing environment. The regression analysis results are also promising, indicating a 0.087 point improvement per minute of watching videos, for which 5 is the highest attainable score. Despite the 12.3% average improvement (using mean minutes of video watching on the regression equation), the R^2 of 0.276 and existence of heteroscedasticity show room for improvement in understanding the impact of peer-to-peer learning for sustainability education. Specifically, students with lower scoring videos appear to be influenced by other unknown factors, based on the heteroscedasticity seen in the regression.

Nonetheless, these findings have some important implications for the use of community-based and collaborative online social environments focusing on immediate problems of waste production (Luna-Nemecio et al., 2020). These results suggest that having more opportunities to view peers' content contributes to score improvement, a phenomenon known as "wisdom of the crowds." Saleh Al-Omouh et al. (2021) described wisdom of the crowds as the intellectual cooperation with shared memories and collective minds to generate new wisdom or knowledge. The role of the wisdom of the crowds to build collective intelligence, for which group intellect is represented, is also mentioned by Cross (2014). According to Cross (2014), group intellect can be enhanced as students collectively build ideas by discarding incorrect or deviant ideas. In the present study, students were able to view the content posted by others before deciding on the format and output of their contributions. Students reported that by referring to content from others, they were able to better implement waste reduction techniques.

Two additional considerations on privacy and task scalability were also considered and should be mentioned. Firstly, to access content on Soqql, students are required to key in an access code onto the mobile application. Content posted on the application is not public and will not be seen by others who are not within the class. There were also no issues observed with students cross sharing content on other public applications. The authors are of the opinion that this is because students had a specific goal to complete assessments using videos. These videos were not "interesting" enough for youths to want to share them on mainstream social media apps like Facebook or Tiktok. The other consideration is the efficiency in which the teacher has to evaluate and provide feedback to the students. Soqql provides a web dashboard where videos can be grouped by student names, allowing videos to be viewed in a consolidated manner. It should be noted that prior to using videos, monitoring of waste audits was done through written essays. According to Cerdan et al., (2018), cognitive load

associated with processing documents increases when the volume of documents increases. Cognitive load theory (Sweller, 1988) is described in which cognitive resources are focused and used in information processing and problem-solving. The use of videos effectively, like short videos with narratives (seen in student videos on Soqql) can help to reduce cognitive load (Brame, 2016). Thus, with the new video-based social learning method on Soqql, the authors are of the opinion that teachers can evaluate student content better.

Based on the findings of peer-to-peer videos' views and comments, several promising future directions can be suggested to further enhance technological design and educational use. For example, techniques like reflective tasks can invoke critical-reflective thinking, as well as encourage students to ask authentic question (Teo, 2019). Gamification is another research area of great promise. The water-food-energy nexus game (Mochizuki et al., 2021) embedded social learning into game-design can encourage complex thinking and enhance collaboration. In addition, the use of challenges in a gamification model can enhance problem-solving and idea generation (Kristian Kiili, 2005), if adapted into an experiential learning model.

The findings yielded by the present study can be of value to educators striving to incorporate an alternative implementation of social media, using student-generated videos, into their curricula to encourage peer-to-peer engagement. Specifically, educators who wish to improve participation in the use of social media in education (Akcaoglu & Lee, 2018; de Lima et al., 2019) will benefit the most. While studies (Schmoelz, 2018; Wu & Chen, 2020) that used student-generated videos for storytelling have been reported to increase co-creation, motivation, and awareness, similar evidence for social networks is sparse. Content sharing can help students improve self-regulation, thus enhancing their critical thinking and collaboration skills, which are essential for twenty-first-century pedagogy (Teo, 2019). Therefore, the authors encourage more studies in this domain to further understand factors involved in peer-to-peer information sharing using modern formats like video.

4.1 Limitations

The main limitation of this study is a small sample size and the difficulty in ascertaining the influence of peers' comments on individual learning outcomes. Thus, larger and more diverse samples should be employed in future studies, which should be based on more exact analysis approaches.

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Declarations of interest

Limitations The Authors declare that there are no conflict of interests.

Appendix: A. Simple Linear Regression for Overall Video Score Against Video Views Per Minute

Model summary—Avg score

Model	Durbin–Watson						
	R	R ²	Adjusted R ²	RMSE	Autocorrelation	Statistic	p
H ₀	0.000	0.000	0.000	3.114	0.853	0.200	<0.001
H ₁	0.526	0.276	0.264	2.671	0.794	0.363	<0.001

ANOVA

Model		Sum of squares	df	Mean square	F	p
H ₁	Regression	163.396	1	163.396	22.896	<0.001
	Residual	428.185	60	7.136		
	Total	591.581	61			

Note The intercept model is omitted, as no meaningful information can be shown

Coefficients

Model	Unstandardized	Standard error	Standardized	t	p
H ₀	14.832 (Intercept)	0.395		37.501	<0.001
H ₁	12.377 (Intercept)	0.615		20.123	<0.001
	0.087 Min	0.018	0.526	4.785	<0.001

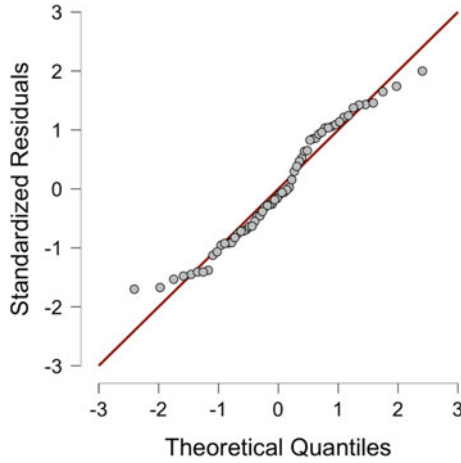
Descriptives

	N	Mean	SD	SE
Avg score	62	14.832	3.114	0.395
Min	62	28.323	18.883	2.398

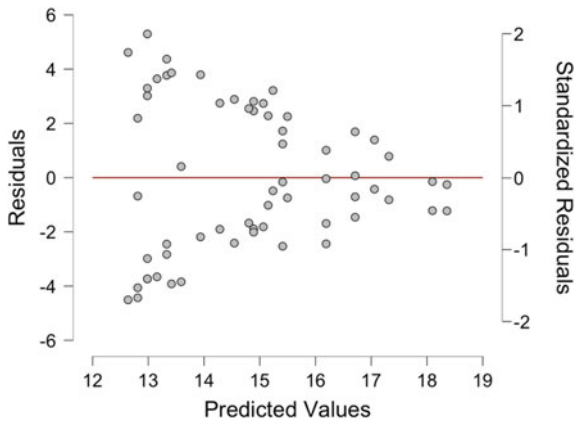
Appendix: B. Pearson’s Correlations for Categories and Minute of Views

Variable		Min	Method	Depth	Presentation	Effort
1. min	Pearson’s r	—				
	p-value	—				
2. Method	Pearson’s r	0.429	—			
	p-value	<0.001	—			
3. Depth	Pearson’s r	0.444	0.972	—		
	p-value	<0.001	<0.001	—		
4. Presentation	Pearson’s r	0.477	0.937	0.928	—	
	p-value	<0.001	<0.001	<0.001	—	
5. Effort	Pearson’s r	0.490	0.958	0.938	0.958	—
	p-value	<0.001	<0.001	<0.001	<0.001	—

Appendix: C. Q-Q Plot for Regression Analysis



Appendix: D. Heteroscedasticity on Smaller Values of the Dataset



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Enhancing the Awareness of e-Mental Health Messages: The Effects of Narrative, Emoji, and Relevance



Chi-Keung Chan and Kelly Ka-Wai Chan

Abstract Computer-mediated communication (CMC) via new digital media has been enriching the forms and modes of human communication. These fast-growing changes have also provided great opportunities for mental health professionals to deliver mental health messages and services more effectively and timely through these new digital media (e.g., mobile apps). Nevertheless, very few research studies have examined the various characteristics of an e-health message on mental health awareness, including the nature of an e-health message, use of emojis in a message, and relevance of a message. The present study conducted an online experimental study with a 2 (Nature of a message: narrative vs non-narrative) \times 2 (Use of emojis: with emojis vs without) \times 2 (Content of a message: relevance vs non-relevance) factorial design. This study recruited 169 university students with moderate mental health status screened by the 18-item Psychological Well-being Scale. After initial screening, the participants were randomly assigned to one of the eight conditions to read an e-mental health message with different combinations of message characteristics. After reading the e-mental health message, the level of mental health awareness (status, message credibility, and personalization) was measured. The results showed that only the main effect of using emojis in e-health messages was significant for mental health status but not for message awareness. The main effects of using narrative and relevant messages were not significant. All two-way interaction effects and the three-way interaction effect were insignificant. This study provides a better understanding of the use of emojis in e-mental health messages for raising awareness of mental health status. Furthermore, the effects among narrative, emoji, and relevance on the awareness of e-mental health messages need to be further investigated.

Keywords Narrative · Emoji · Relevance · Awareness · e-Mental health message

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1 Introduction

During the Covid-19 pandemic, more e-mental health messages appear via digital technologies. According to Wong et al. (2020), about one in three adolescents met the clinical criteria of anxiety disorder before age 18. For elderly adults who aged over 60, the percentages of feeling lonely (59.5%), with moderate loneliness (42.4%) and severe loneliness (27.7%) after the outbreak of Covid-19, were much higher than the situation before the outbreak of Covid-19 (29.9% for feeling lonely, 31.8% for moderate loneliness, and 8.8% for severe loneliness). These increasing and urging mental health issues during the pandemic have been accelerating the movement for digital communication of mental health messages.

Computer-mediated communication (CMC) via new digital media has been enriching the forms and modes of human communication. Communications of health messages have turned their promotion via mobile phones. These changes have significantly been enhancing the perception of health messages (Hudson et al., 2012), improving motivation for doing exercises among patients with heart disease (Legler et al., 2018), increasing prosocial behaviours and empathetic motivations among young people (Konrath et al., 2015), facilitating engagement in intimate behaviours (Gesselman et al., 2019), and strengthening sex and reproduction intervention (Feyisetan et al., 2015). Furthermore, these changes have also provided great opportunities for mental health professionals to deliver mental health messages and services more effectively and timely through these new digital media (e.g., mobile apps). An experiment by Jini and Prabu (2019) found that people suffering from stress were easier to express their feelings on social networking sites. They also revealed that an online platform is beneficial for stressed people to understand and pay attention to their mental health (Jini & Prabu, 2019).

Online promotion of e-mental health messages has commonly adopted two significant elements in enhancing awareness—narrative and emoji. Narrative stories have been used to enhance the effectiveness of message presentation by creating a feeling of verisimilitude and touch viewers' hearts (Shin & Kang, 2017). Persuasion and transportation are two possible cognitive mechanisms to explain the effectiveness of narrative messages (Willoughby & Liu, 2018). Besides, a variety of emojis provide an alternative way for emotional expressions with facial expression or objects using the new digital media. Thus, Willoughby and Liu (2018) also found that using emojis can significantly increase viewers' attention to health messages. They did not find a significant interaction effect between emoji and narrative on message awareness and suggested that message relevance could be a potential factor (Willoughby & Liu, 2018). Nevertheless, very few research has investigated the effect of message relevance on the awareness of e-mental health messages.

Thus, the main purpose of this experimental study is to investigate the main effects and interaction effects of the nature of a message (narrative vs. non-narrative), the use of emojis in a message (with emojis vs. without), and the content of a message (relevance vs. non-relevance) on enhancing awareness of e-mental health messages. Conceptually, the present study can provide a more in-depth understanding

of whether the use of emojis and relevance in a narrative message could enhance individuals' awareness of the message and their mental health. Practically, the findings of the present study can provide recommendations for designing effective e-mental health messages to arouse target viewers' awareness.

1.1 Narrative

The narrative approach is a means for people to express their experience like a story combining emotions, beliefs, and values to create an empathetic feeling to the message. The narrative approach also includes a description of the settings and plots of the situation. It usually provides different perspectives, goals, plans, actions, and consequences of the characters in the scenarios (Kopfman et al., 2009). The use of narrative message not only provides a valuable channel for people to understand their own experience, but it can also facilitate the recovery pathway of people with mental illness as storytelling can enhance empathy from readers and their feelings of empowerment (Kirkpatrick, 2005; Llewellyn-Beardsley et al., 2019).

Willoughby and Liu's research (2018) suggested that persuasion and transportation in a narrative message provide attraction and emotional reaction to the message. There are two types of persuasion from the elaboration likelihood model suggested by Petty and Cacioppo (1986), including central route and peripheral route. Willoughby and Liu (2018) suggested that narrative e-mental health messages can enhance receivers' awareness through emphasizing central-route deep processing. Transportation is an emotional reaction that can provide mental imagery that helps people immerse themselves in the narrative story. Transportation can also provide a mechanism for changing one's attitude, belief, and behaviour (Green & Clark, 2012), and facilitate information acceptance (Green, 2006; Murphy et al., 2013). Persuasion is the information processing mechanism while transportation is the facilitation mechanism. When combining these two mechanisms, this can explain why a narrative message is possible to increase awareness of e-mental health messages. Hence, Willoughby and Liu (2018) found a significant main effect on message processing using the narrative message.

1.2 Emoji

Emoji was frequently used in computer-mediated communication (CMC) and instant message (IM). Toksöz (2018) explained the composition of the word "Emoji." Emoji is a Japanese word, e (絵) means picture, and moji (文字) means character. Several research has discovered the benefits of using emojis in text messaging, like providing encouragement and motivation for people with physical illness (Legler et al., 2018), increasing one's prosocial behaviours and empathetic motivations (Konrath et al., 2015), and engaging more intimate behaviours in their daily life (Gesselman et al.,

2019). Several researchers also discovered that emojis could help to simplify the content and intended tone of an instant message to reduce uncertainty and equivocality of the messages (Aldunate & Gomez-Ibanez, 2017; Kaye et al., 2017; Riordan, 2017). Furthermore, a positive message with positive emojis can increase positivity and happiness than not using an emoji (Riordan, 2017). These findings implied that emojis' can provide alternative ways to express emotions, increase happiness in a person, and facilitate one's emotions.

Although the significance of emojis on mental health messages has seldomly been discussed, Phan et al. (2017) discovered that emojis can express emotions of a health message more accurately than words. In the study of Lotfinejad et al. (2020), they found that a message with emojis can also help communicate complex health concepts more effectively and raise awareness of people to adopt healthy behaviours. Besides, Willoughby and Liu (2018) examined the effect of combining narrative with emojis in health text intervention. Nevertheless, they did not find a significant interaction effect between emoji and narrative and suggested that message relevance can be a potential moderator.

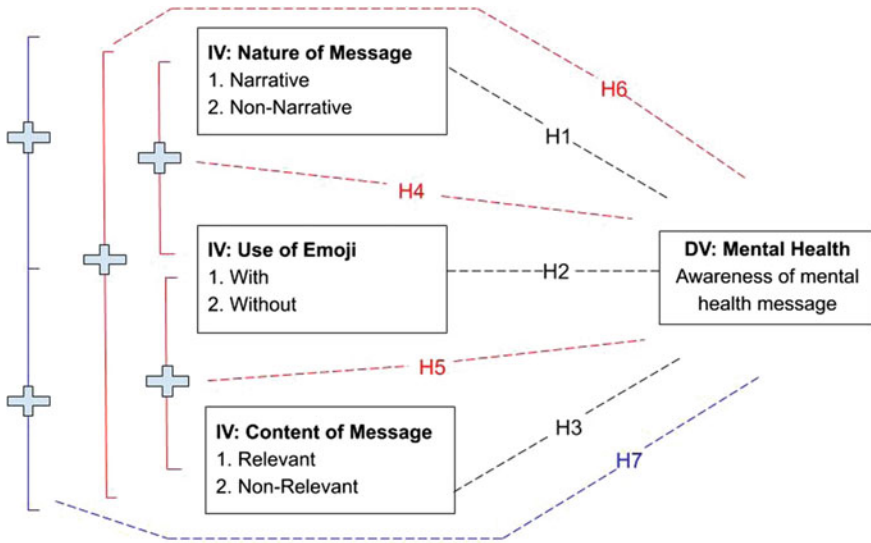
1.3 Relevance

Cambridge Dictionary defines relevant as “connected with what is happening or being discussed.” (“Relevant,” n.d.a). Merriam-Webster defines relevance as “having a significant and demonstrable bearing on the matter at hand.” (“Relevant,” n.d.b). Thesaurus.com suggested the synonyms of relevant as applicable, influential, and significant (“Relevant,” n.d.c). It is important to note that relevance defines something essential and connected to a person.

Willoughby and Liu's research (2018) discovered a significant main effect on the personalization of an e-health message with emojis. They also suggested that personalization can increase the attentiveness, cognitive involvement, and recall of the message from the readers. Their research did not find an interaction effect between narrative and emojis on the personalization of an e-health message. A key limitation may be due to the differences in personal backgrounds and lifestyles, suggesting the importance of relevance in an e-mental health message. It is interesting to investigate how the relevance of an e-mental health message can enhance the awareness.

1.4 The Present Study, Conceptual Framework, and Hypotheses

Figure 1 depicts the conceptual framework of the present study based on the above literature review. Seven research questions and hypotheses were derived from this conceptual framework:



Note 1: H1, H2, H3 are the main effects between variables to the DV
Note 2: H4, H5, H6 are the interaction effects between variables to the DV
Note 3: H7 is the interaction effects among three variables to the DV

Fig. 1 Conceptual framework of the present study

RQ1: Does using a narrative message significantly enhance participants’ awareness of the e-mental health message more than a non-narrative one?

H1: Narrative message significantly enhances participants’ awareness of the e-mental health message more than a non-narrative one.

RQ2: Does the use of emojis in a message significantly enhance the awareness of the e-mental health message more than a message without using emoji?

H2: The use of emojis in a message significantly enhances participants’ awareness of the e-mental health message more than a message without using emojis.

RQ3: Does the relevance of a message significantly enhance participants’ awareness of the e-mental health message more than an irrelevant one?

H3: Relevance of a message significantly enhances participants’ awareness of the e-mental health message more than an irrelevant one.

RQ4: Do the participants reading a narrative message with the use of emojis significantly enhance participants’ awareness of the e-mental health message?

H4: Narrative message with the use of emojis significantly enhances participants’ awareness of the e-mental health message.

RQ5: Does the use of emojis in a relevant message significantly enhance participants’ awareness of the e-mental health message?

H5: The use of emojis in a relevant message significantly enhances participants’ awareness of the e-mental health message.

RQ6: Do participants read a narrative message with relevant content significantly enhances participants’ awareness of the e-mental health message?

H6: Narrative message with relevant content significantly enhances participants' awareness of the e-mental health message.

RQ7: Do participants read a narrative message using emojis and relevant content significantly enhance participants' awareness of the e-mental health message?

H7: Narrative message with the use of emojis and relevant content significantly enhances participants' awareness of the e-mental health message.

2 Methods

2.1 Participants

The present study examines how the elements of narrative nature, use of emojis, and content relevance influence individuals' awareness of e-mental health messages. Snowball sampling was employed to recruit subjects for this online experiment. At the initial stage, eight potential participants were first recruited at a self-financing university in Hong Kong, and these participants requested to help recruit other potential target participants (college students aged 18–23). The participants were recruited for this study via online instant messaging platforms such as Telegram, WhatsApp, and WeChat. One-hundred sixty-nine ($n = 169$) university students (65.1% females and 34.9% males) with fluent spoken Chinese and moderate mental health status were recruited to participate in this online experiment. After initial screening, participants were randomly assigned to one of the eight conditions and read an e-mental health message. After reading the e-mental health message, their level of awareness of their mental health status and e-health message were measured. During this process, participants were reminded that no identifiable personal data were required for the experiment.

Since the level of psychological well-being of the participants could be a confounding variable, only participants within a moderate level of psychological well-being were selected in this study. An initial mental health status questionnaire was used in screening and selecting participants with moderate mental health status.

2.2 Measures and Materials

Initial Mental Health Status. A shortened 18-item Psychological Well-being Scale by Ryff and Keyes (1995) was administered to the participants to measure their initial level of mental health status. The participants rated 18 items of six subscales on a 7-Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree).

The mental health status followed the scoring system provided by Ryff et al. (2010) and Ryff and Keyes (1995). Among the 18 questions, Q4, Q5, Q6, Q7, Q10, Q14, Q15, and Q16 are reverse-scored items. Participants with higher scores meant

higher levels of psychological well-being. People who scored 18–45 are classified as having low psychological well-being, those with 46–98 are classified as having moderate psychological well-being, and those with 99–126 are classified as having high psychological well-being. In this study, both scored low and high psychological well-being participants were excluded from the experimental analyses. According to Bayani et al. (2008), the test–retest reliability coefficient of Ryff’s Psychological Well-being Scales was 0.82.

Message Materials. There were eight types of e-mental health messages (eight conditions) with various combinations of narrative and non-narrative, with or without emojis, and relevance or non-relevance. All messages were written in traditional Chinese. These different types of messages were used to examine the impact of various combinations on message awareness, including message credibility and message personalization.

For conditions based on the elaboration model, this study included either narrative or non-narrative types of messages. For the narrative message, a story-like e-mental health message showed how the character finds ways to improve his/her mental health. For the non-narrative message, the e-mental health message presented a descriptive storyline with logical and factual mental health prevention information (Lemal & Van den Bulck, 2010). For conditions with the use of emojis, the study included e-health messages with emojis or without emojis. For the message with emojis, the frequency of emoji was one emoji for each sentence. For the message without emoji, the e-health message was shown as plain text only. For conditions related to the relevance of messages, the study included two different scenarios that were relevant and non-relevant to personal differences. For the relevant situation, academic stress in college was used to focus on participants’ current academic difficulties. While the non-relevant situation was about the full-time working stress that might not be totally relevant to the target participants’ current life difficulties because majority of undergraduate students in Hong Kong studied full-time. The various combinations led to eight different types of conditions as follows:

1. Narrative message with emojis and relevance
2. Narrative message with emojis and non-relevance
3. Narrative message without emoji and relevance
4. Narrative message without emoji and non-relevance
5. Non-narrative message with emojis and relevance
6. Non-narrative message with emojis and non-relevance
7. Non-narrative message without emoji and relevance
8. Non-narrative message without emoji and non-relevance.

Mental Health Awareness. The effectiveness of various combinations of messages in raising mental health awareness were measured by two dependent variables: Message credibility and message personalization.

Appelman and Sundar (2016) found significant results on discovering message credibility which could be measured by self-rating on three items: accurate, authentic, believable. These three items focus on people’s perception of message credibility on the process of people making a judgment on the message. In this study, the questions on message credibility were assessed to understand participants’ awareness

of different types of messages among participants. Thus, message credibility was measured by participants responses on the three items with a 7-Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree) on the extent they agreed or disagreed that the messages are accurate, authentic, and believable (Appelman & Sundar, 2016; Willoughby & Liu, 2018).

Kreuter and Strecher (1996) proposed that message personalization could be significant in recalling, receiving, and increasing the attentiveness of a piece of information. Willoughby and Liu's research (2018) also found significant main effects of personalization in narrative messages and messages with emojis. It is suggested that personalization can vary people attentiveness to a piece of information. In the present study, the question on personalization also helps to discover participants' level of awareness for different types of messages. So, personalization was measured by participants' responses to a 7-Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree) on the extent they agreed or disagreed that "The message applies to me" and "The message is designed for me." (Willoughby & Liu, 2018).

Overall, people with higher scores on message credibility and personalization represented a higher level of awareness of the mental health message.

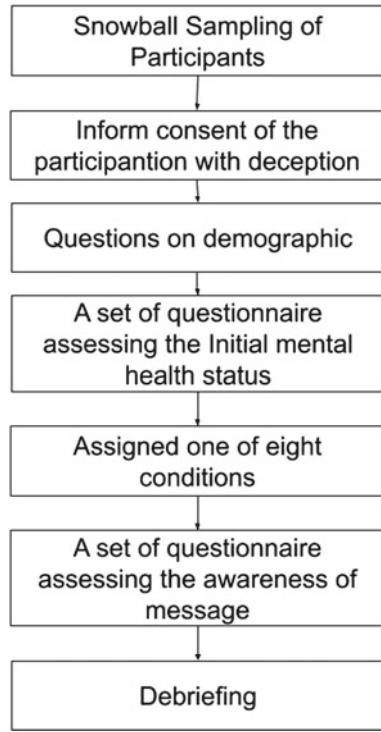
2.3 Procedures

The online experiment was conducted via instant messaging platforms (i.e., Facebook and WhatsApp) and consisted of seven parts (see Fig. 2). Convenient and snowball sampling methods were adopted to recruit participants as mentioned above. First, all the selected participants received an e-consent form prior to the study. Deception procedure was adopted at the beginning of the experiment to hide the real purpose of the study to ensure the internal validity of the results. At the beginning of the online experiment, participants were told that this study was about e-mental health mobile intervention. Then, an initial mental health status questionnaire described above was filled by the participants for selecting those scored 46–98 with moderate psychological well-being. After that, the selected participants were randomly assigned to one of the eight conditions. After reading the assigned e-mental health message (2–3 min), participants were requested to complete a questionnaire regarding the message credibility, message personalization, and mental health awareness. Lastly, an e-debriefing form was shown to the participants for explaining the deception process and the real purpose of the study. The entire online experiment lasted approximately 12 min for each participant.

2.4 Pilot Test

A pilot study was conducted with 17 participants to try out the experimental procedures and materials of the experiment. In the pilot test, there were 2 participants for

Fig. 2 Flowchart of the experimental procedures in the present study



seven conditions and 3 participants for one condition. After the pilot study, some participants expressed that the experimental procedures were a bit confused because there was inadequate guidance and instruction, especially the purpose of showing the messages. Thus, the researchers made one modification by adding the introduction and guidelines to each part of the online experimental study. A short paragraph was included for more explicit instructions. Data collected in the pilot study were excluded from the final data analysis.

2.5 Ethical Considerations

During the online experiment, the conditions might trigger participants' emotions. Such discomfort, however, should be no greater than what they experience in everyday life. Participation in the online experiment was completely voluntary. Participants could stop and withdraw from the online experiment at any time if they felt uncomfortable without negative consequences.

All collected data were saved securely and confidentially. The data can only be accessed and analyzed by the authors. No identifiable information was required in

the online survey; The collected data will be destroyed five years after the completion of the present study.

3 Results

The present study adopts a 2 (Nature of message: narrative or non-narrative) × 2 (Use of emojis: with or without) × 2 (Content of message: relevance or non-relevance) factorial experimental design. The nature of the message, the use of emojis, and the message content were the independent variables whereas the mental health status and message awareness (credibility and personalization) of mental health information were the dependent variables. Three-way ANOVA was employed to analyze the data to test the three main effects (H1-H3), three two-way interaction effects (H4-H6), and one three-way interaction effect (H7).

3.1 Descriptive Statistics

Table 1 shows the mean scores and standard deviations of the mental health status and mental health awareness (including message credibility and personalization) across

Table 1 Descriptive Statistics of mental health status and mental health awareness

Variables	Sample size	Mental health status		Message credibility		Message personalization	
		Mean	SD	Mean	SD	Mean	SD
Condition 1	20	81.50	6.69	14.50	1.82	8.85	1.53
Condition 2	21	78.61	11.60	14.29	2.26	9.24	2.90
Condition 3	24	85.58	9.89	15.04	1.92	8.75	1.82
Condition 4	20	78.35	9.40	15.20	2.26	9.25	2.20
Condition 5	22	80.09	12.41	14.82	2.11	9.09	2.35
Condition 6	21	79.95	19.98	13.67	3.77	8.86	3.47
Condition 7	21	86.29	11.27	14.48	2.62	7.76	3.06
Condition 8	20	86.15	16.20	14.75	2.69	7.75	2.75

Notes

- Condition 1 = Narrative message with emojis and relevance
- Condition 2 = Narrative message with emojis and non-relevance
- Condition 3 = Narrative message with no emoji and relevance
- Condition 4 = Narrative message with no emoji and non-relevance
- Condition 5 = Non-narrative message with emojis and relevance
- Condition 6 = Non-narrative message with emojis and non-relevance
- Condition 7 = Non-narrative message with no emoji and relevance
- Condition 8 = Non-narrative message with no emoji and non-relevance

the eight conditions. In this study, 169 participants were recruited. Given the initial screening criteria, the mean scores on the Psychological Well-being scale were within the moderate levels (48–96) for all eight conditions. The results revealed that the mean scores of psychological well-being were from 78.35 to 86.29 and the standard deviations were from 6.69 to 16.20. The one-way ANOVA results showed that there was no significant difference on mental health status across the eight groups, $F = 1.505, p = 0.169$.

For message credibility, the highest total possible score is 21. The mean scores of message credibility were from 13.67 to 15.20 between groups. The standard deviations of the message credibility across groups were from 1.82 to 3.77. The one-way ANOVA results showed that there was no significant difference on message credibility across the eight groups, $F = 1.142, p = 0.340$.

For the personalization in mental health awareness, the highest total possible score is 14. The mean scores across eight groups were between 7.75 and 9.25. The standard deviations of personalization were between 1.53 and 3.47. The one-way ANOVA results showed that there was no significant difference on message credibility across the eight groups, $F = 0.788, p = 0.598$.

3.2 Main and Interaction Effects on Mental Health Status

Interaction effects. Table 2 shows that the interaction effect between the nature of the message and the use of emojis was not significant, $F = 1.189, p = 0.277, \eta^2 = 0.007$. The interaction effect between the use of emojis and the content of message was also insignificant, $F = 0.306, p = 0.581, \eta^2 = 0.002$. The interaction effect between the nature of message and the content of message was insignificant, $F =$

Table 2 The three-way Anova results on mental health status

Variables	df	<i>F</i>	p	η^2
Nature of message (A)	1	1.148	0.286	0.007
Use of emojis (B)	1	4.246	0.041	0.026
Content of message (C)	1	1.745	0.188	0.011
Interaction (A × B)	1	1.189	0.277	0.007
Interaction (B × C)	1	0.306	0.581	0.002
Interaction (A × C)	1	1.565	0.213	0.010
Interaction (A × B × C)	1	0.307	0.581	0.002

Notes

- Interaction (A × B) = Interaction between the nature of message and the use of emojis
- Interaction (B × C) = Interaction between the use of emojis and the content of message
- Interaction (A × C) = Interaction between the nature of message and the content of message
- Interaction (A × B × C) = Interaction among the nature of message, the use of emojis, and the content of message

1.565, $p = 0.213$, $\eta^2 = 0.010$. Moreover, the three-way interaction among the nature of message, the use of emojis, and the content of message were insignificant as well, $F = 0.307$, $p = 0.581$, $\eta^2 = 0.002$.

Main effects. The three-way ANOVA results show that there was a significant main effect on mental health status for the use of emojis (with or without emoji), $F = 4.246$, $p = 0.041$, $\eta^2 = 0.026$. Nevertheless, the main effects were insignificant for the nature of message (narrative or non-narrative), $F = 1.148$, $p = 0.286$, $\eta^2 = 0.007$, and for the main effect for the content of message (relevance or non-relevance), $F = 1.745$, $p = 0.188$, $\eta^2 = 0.011$.

3.3 Main and Interaction Effects on Message Credibility

Interaction effects. Table 3 shows that the interaction effect between the nature of the message and the use of emoji was insignificant, $F = 0.216$, $p = 0.643$, $\eta^2 = 0.001$. The interaction effect between the use of emoji and the content of message was also insignificant, $F = 1.369$, $p = 0.244$, $\eta^2 = 0.008$. The interaction effect between the nature of message and the content of message was insignificant as well, $F = 0.286$, $p = 0.594$, $\eta^2 = 0.002$. The three-way interaction among the nature of the message, the use of emoji, and the content of the message were insignificant, $F = 0.469$, $p = 0.494$, $\eta^2 = 0.003$.

Main effects. For message credibility, Table 3 shows that the main effect for the nature of message (narrative or non-narrative) was insignificant, $F = 0.734$, $p = 0.393$, $\eta^2 = 0.005$. The main effect for the use of emojis (with or without emoji) was also insignificant, $F = 2.045$, $p = 0.155$, $\eta^2 = 0.013$. Also, the main effect of the

Table 3 The Three-way ANOVA results on message credibility

Variables	DF	F	p	η^2
Nature of message (A)	1	0.734	0.393	0.005
Use of emoji (B)	1	2.045	0.155	0.013
Content of message (C)	1	0.369	0.544	0.002
Interaction (A × B)	1	0.216	0.643	0.001
Interaction (B × C)	1	1.369	0.244	0.008
Interaction (A × C)	1	0.286	0.594	0.002
Interaction (A × B × C)	1	0.469	0.494	0.003

Notes

- Interaction (A × B) = Interaction between the nature of message and the use of emojis
- Interaction (B × C) = Interaction between the use of emojis and the content of message
- Interaction (A × C) = Interaction between the nature of message and the content of message
- Interaction (A × B × C) = Interaction among the nature of message, the use of emojis, and the content of message

content of the message (relevance or non-relevance) was insignificant as well, $F = 0.369, p = 0.544, \eta^2 = 0.002$.

3.4 Main and Interaction Effects on Credit Personalization

Interaction effects. For message personalization, Table 4 shows that the interaction effect between the nature of message and the use of emoji was insignificant, $F = 2.186, p = 0.141, \eta^2 = 0.013$. The interaction effect between the use of emoji and the content of message was also insignificant, $F = 0.044, p = 0.834, \eta^2 < 0.001$. The interaction between the nature of message and the content of message was insignificant as well, $F = 0.510, p = 0.476, \eta^2 = 0.003$. The three-way interaction among the nature of message, the use of emoji, and the content of message was insignificant as well, $F = 0.005, p = 0.945, \eta^2 < 0.001$.

Main effects. Table 4 shows that the main effect of the nature of message (narrative or non-narrative) was insignificant, $F = 2.739, p = 0.100, \eta^2 = 0.017$. The main effect for use of emoji (with or without emoji) was also insignificant, $F = 2.527, p = 0.114, \eta^2 = 0.015$. Also, the main effect for the content of message (relevance or non-relevance) was insignificant as well, $F = 0.164, p = 0.686, \eta^2 = 0.001$.

In sum, the three-way ANOVA results showed that the nature of message, the use of emoji, and the content of message did not have any significant main effect or interaction effect on message awareness in terms of message credibility and message personability. For awareness of mental health status, only the main effect of the use of emoji was significant.

Table 4 The Three-way ANOVA results on message personalization

Variables	df	F	p	η^2
Nature of message (A)	1	2.739	0.100	0.017
Use of emoji (B)	1	2.527	0.114	0.015
Content of message (C)	1	0.164	0.686	0.001
Interaction (A x B)	1	2.186	0.141	0.013
Interaction (B x C)	1	0.044	0.834	<0.001
Interaction (A x C)	1	0.510	0.476	0.003
Interaction (A x B x C)	1	0.005	0.945	<0.001

Notes

- Interaction (A × B) = Interaction between the nature of message and the use of emojis
- Interaction (B × C) = Interaction between the use of emojis and the content of message
- Interaction (A × C) = Interaction between the nature of message and the content of message
- Interaction (A × B × C) = Interaction among the nature of message, the use of emojis, and the content of message

4 Discussion

Communications of mental health messages have turned their promotion via an online platform with emerging digital technologies (Hudson et al., 2012). A message could be affected by the nature of the message, the use of emojis, and the content of message (Willoughby & Liu, 2018). Hence, the aim of this study focuses on the main effects of the nature of message, the use of emojis, and the content of message on mental health awareness. The present study also studies the interaction effects of these three factors to determine whether a message combined with the nature of message, the use of emojis, and the content of message can enhance viewer's mental health awareness.

It is hypothesized (H1) that reading a narrative text message has a significant main effect on awareness of mental health information than reading a non-narrative one. The results showed that there was no significant main effect in reading both narrative and non-narrative text. The results were inconsistent with the hypothesis (H1). Hinyard and Kreuter (2007) suggested that a narrative message using a coherent story with a recognizable beginning, middle, and end that gives information about the scene, character, conflict, and determination can change behaviour. This means that the content of the narrative message should have a chronological series of an event. Hong (2011) suggested that a narrative message with a coherent story significantly enhances the level of transportation than a non-narrative message. The narrative message with a complete story may have a stronger effect on attitudes and intentions than the non-narrative message (Murphy et al., 2013).

The findings were partially consistent with the hypothesis (H2) and the main effect of using emojis significantly raised participants' awareness of their mental health status. Several studies found that emojis connected to personal emotions can enhance the understanding of a message (Riordan, 2017; Toksöz, 2018). The use of emojis can help disambiguate the information of the text message and reduce unclarity (Aldunate & Gomzalez-Ibanez, 2017; Kaye et al., 2017; Riordan, 2017). Nevertheless, according to Willoughby and Liu's (2018) research, they found a message without emoji is more helpful than a message with emojis when the text message is clear enough to the viewers and they already trust and engage in the content of the message. The contradictory perspectives suggest that the effectiveness of the use of emojis in raising message awareness depends on the message clarity and intensity.

For the content of message, it is hypothesized (H3) that the relevance of a message significantly enhances the awareness of an e-mental health message than a non-relevant message. The results showed that there was no significant main effect of the relevance of a message. The results were inconsistent with the hypothesis (H3). According to Anghelcev and Sar's (2011) research, they suggested that the effectiveness of raising a participant's awareness of a health message is due to positive mood and high message relevance. They defined message relevance as the degree to how the message is perceived by the recipient, including personal goals, values, and interests. The message can increase persuasion elements by increasing message involvement (Anghelcev & Sar, 2011). In the present study, the relevance of the message should be tailored to personal mental health needs of each participant. The

details of the messages can increase the persuasion of a message when viewers can perceive the relevance of a message (Anghelcev & Sar, 2011).

It is hypothesized (H4) that reading a narrative message with the use of emojis can significantly enhance the awareness of mental health messages. The results showed no significant interaction effect for a combination of narrative message with the use of emojis. The results were inconsistent with the hypothesis (H4). Willoughby and Liu's research (2018) suggested that the processing and attention of a narrative message could be enhanced with emojis. The greater attention also suggested that the recipient is more likely to process the message peripherally (Petty & Cacioppo, 1981). The peripheral processing may influence individuals' attitudes or behaviours by cues (emojis) from messages (Willoughby & Liu, 2018). The use of emojis may strengthen the attention of the narrative message. In the present study, the narrative message (was not tailor-made) with emojis (too few and non-attractive emojis) may not have strong attention and persuasion in influencing the participants. When the message has greater attention and persuasion elements in the narrative message with emojis, the effect of the narrative message with emojis on message awareness may be more explicit.

It is hypothesized (H5) that the use of emojis with more relevance to the message significantly enhance the awareness of mental health message. The results showed that there was no significant interaction effect on emotional awareness in the use of emojis with more message relevance. The results were inconsistent with the hypothesis (H5). Yus (2014) suggested that under the relevance-theoretic perspective, the emojis lead to a more fine-grained interpretation of a message in terms of the underlying attitudes, feelings, and emotions by viewing the message by reducing mental effort. It implies that message relevance with emojis could reduce the mental effort in a perceived message. With lower mental effort in perceiving the message, the overall feeling of verisimilitude could be enhanced. In the present study, the use of emojis with a relevant message has a limited effect on raising awareness. The message should further reduce the mental effort for the individuals in perceiving the message. By reducing the mental effort in reading a relevant message with more use of emojis, the effect on health message awareness would be more explicit.

Furthermore, this study hypothesizes (H6) that reading a narrative and relevant message can significantly enhance the awareness of mental health messages. The results showed no significant interaction effect in reading a narrative and relevant message. The results were inconsistent with the hypothesis (H6). A message with the narrative approach is to contextualize the information in the forms of stories, anecdotes, and cases (Winter et al., 2013). The dialogues in a message under the narrative approach can engage individuals to make personal conceptualization and decision-making on the message content. At the same time, the use of relevance of a message is to provide an authentic feeling to the readers. An authentic feeling felt relevant for the readers to pull information from the back to the front (Petraglia, 2009). It also enables the individuals to understand how the information can relate to their everyday life in an emotional and cognition aspect. The combination of the use of narrative and the feeling of connectedness in a mental health message can enhance the authenticity of a message. In contrast, the narrative and relevant message have

limitation on the content of a message. Winter et al. (2013) suggested that the content of a message should tailor-make the materials based on the heterogeneity and shifting identities to fit the interests of the individuals. In the present study, it is argued that the strength of the message was insufficient to provide feelings of authenticity. The message should be more tailor-made that fit to individualized mental health status and provide a more authentic feeling to the readers.

Finally, the present study hypothesizes (H7) that reading a narrative message with the use of emojis and more relevance can significantly enhance the awareness of mental health messages. The results showed that this three-way interaction effect was insignificant and was inconsistent with the hypothesis (H7). Willoughby and Liu's (2018) research suggested that the effect of using emojis in a health message depends on the objectives and content of a message. Previous research found no significant interaction effect between narrative and emoji use, emoji use and relevance, and narrative and relevance. Nevertheless, future research should further examine the interaction effects among narrative, emojis, and relevance.

5 Limitations

This research focuses on the main and interaction effects of three key characteristics in a mental health message (narrative nature, use of emoji, and relevant content) on enhancing mental health awareness. There were several limitations to this study. First, the strength of the narrative messages can be enhanced. The attention and persuasive elements may not be strong enough to draw an individual's awareness of the mental health messages. Thus, the persuasiveness of a narrative message should be strengthened. Second, the relevance of message may be too weak for enhancing the authentic feelings of viewers. Hence, the content of relevant message should be strengthened to enhance the connectedness between the message and the individuals. Third, the difference between the relevant (academic stress) and non-relevant (work stress) messages may not make a significant difference. Both scenarios were relevant to the mental health status of university students (some of them worked part-time). Fourth, variation in message reading time could be a confounding factor. The participants could read the messages several times before they moved to the next session, the longer reading time may provide a further understanding of the message and lead to quite different responses that may affect the results. Thus, the time of reading the message should be manipulated. Fifth, age could be a confounding factor because the younger generation feels more comfortable to read online messages. The target of this study was undergraduates and this might lead to restriction of range. Thus, further studies should cover a wider age range.

6 Conclusion

To conclude, few research have investigated the interplays between the narrative, emojis, and relevance on mental health awareness. This study provides some new directions for understanding the influences of the use of narrative (nature of the message), emoji (use of emoji), and relevance (content of the message) and how these three elements influence the awareness of e-mental health messages and individuals' mental health. Although the results did not indicate that narrative, use of emojis and relevant messages significantly enhanced mental health awareness, this study gave a new idea of addressing the importance of the narrative, emoji, and relevance in a message. During the Covid-19 pandemic, online platforms have become a new paradigm for digital communication. The increasing mental health problems due to the pandemic and chaotic social world suggest that proactive e-mental health prevention will be the future trend of intervening these problems. The tailored e-mental message with an authentic narrative story and the use of emojis can provide a way for people to be aware of their mental health status. Thus, future studies should further examine and deeply investigate the effectiveness, efficiency, and fidelity of using narrative, emoji, and relevance of a message in e-mental health promotion and prevention.

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Exploring a Self-paced Online Course Design, Learning Engagement, and Effectiveness on Anti-cyberbullying Topic for Adolescents in Hong Kong



Min Lan

Abstract Designing a self-paced online course for anti-cyberbullying among adolescents is one of the feasible approaches to reduce the cyberbullying problems. In this study, we develop an online course grounding on the needs of stakeholders and explore the behavioral learning engagement and the course effectiveness regarding attitude, empathy, and coping skills toward cyberbullying. To do so, group interviews, k-means clustering, and comparative analysis were conducted. We found the feature of attractiveness was the core of the course design, in particular course contents need to be relevant to participants daily life (i.e., connectedness), course activities allowed participants to have interaction with contents (i.e., interactiveness), and course materials should be visualized to reduce cognitive load and provide clear instruction (i.e., visualization). Regarding the online behavioral learning engagement, three types of learning were identified: Dropouts, Responders (i.e., content-interaction-oriented learner), and All-rounders (i.e., active learners). In terms of course effectiveness, there were no significant differences on the changes of attitude, empathy, and coping skills, in general, but Responders had significant positive changes on coping skills. The underlying explanation of the changes were discussed. Long-term-based studies and integrated programs with this online course were expected to be conducted in the future.

Keywords Online course design · Behavioral engagement · Course effectiveness · Cyberbully · Adolescent

1 Background

With the increase of digital socialization and entertainment, adolescents' cyber well-being issue has been brought to the attention. Recently, cyberbullying issues have been recognized as one of the cyber effects that could negatively influence adolescents'

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cyber wellness. According to UNICEF (2019), over 33% of adolescents in 30 countries indicated that they had been a victim of a cyberbullying incident. In Asia, based on a self-reported study (HKPA, 2016), 72.9% of 3965 adolescents from Hong Kong, Macau, Taipei, Singapore, and Guangzhou reported that they had been cyberbullied. The seriousness of the prevalence of cyberbullying issues went without saying.

Previous studies have shown the negative influences from both the cyber aggression and cyber victimization. The experiences of cyberbullying were associated with psychological disorders (e.g., depression and anxiety), emotional difficulties with peers (Lozano-Blasco et al., 2020), and were at risk of suicidal behaviors and suicidal ideation (John et al., 2018). However, with more exposure but without the knowledge about cyberbullying, adolescents may not be aware of the intentional aggressive online behaviors and corresponding negative effects toward them.

From an educational perspective, there is a need to create educational programs to prevent these adolescent cyber-bystanders from imitating those cyberbullying behaviors to their peers. As of 2020, a group of educational programs was designed for the purpose of anti-cyberbullying, but the effectiveness of these programs was controversial. Gaffney et al.'s (2019) meta-analysis revealed the anti-cyberbullying program during 2000 and 2017 reduced cyber aggression and cyber victimization by around 10–15%, while Mishna et al. (2011) and Cantone et al. (2015) doubted the positive effects on reducing cyberbullying behaviors, especially from the long-term perspective.

A recent systematic review and meta-analysis study (Author et al., under review) reexamined 19 current anti-cyberbullying educational programs from a socio-ecological system. Majority of these reviewed programs were through face-to-face (f2f) instructions or training in a class or school. The review revealed that those anti-cyberbullying programs with the interactive practice design among peers had higher effectiveness on reducing both cyber aggression and cyber victimization. Even so, before the interactive activities, individuals need knowledge about cyberbullying to raise their awareness and improve their coping skills. Researchers (Leung et al., 2019) suggested that the teacher-centered knowledge-delivery style instruction can be transformed into the form of self-paced online courses, which is more accessible to a larger number of target audiences. Moreover, Pieschl et al. (2017) said that a low-cost and low-threshold access to cyberbullying prevention was more affordable for schools.

In this study, we designed a self-paced online course based on stakeholders' feedback and suggestions on the topic of cyberbullying. This online course aimed to enhance adolescents' knowledge about the concept, different types of cyberbullying behaviors, the negative consequences from cyberbullying incidents, and the coping skills for anti-cyberbullying. Moreover, based on this grounding-designed online course, we explored the online participants' learning engagement with these self-paced activities. Meanwhile, the effectiveness of this online course regarding the participants changes on their attitude toward cyberbullying, empathy toward victims, and coping skills to deal with cyberbullying incidents.

2 Literature Review

2.1 *Online Course for Anti-cyberbullying*

There are few online course resources for anti-cyberbullying available for learning. To our knowledge, there are currently only two studies about online course development for anti-cyberbullying. Brewer (2010) used multimedia WebQuest to teach cyberbullying knowledge for middle school students, which increased students' awareness and knowledge. Recently, Leung et al. (2019) developed an anti-cyberbullying online course on Moodle for college students in Hong Kong, which indicated that it could enhance participants' knowledge, promote prosocial behavior, and reduce cyber aggression.

To enhance the engagement and effectiveness of online learning, different principles were applied to guide the online course design. The design of Leung et al.'s (2019) Moodle course was based on five principles of constructivist instruction. First, course participants' opinions are valued. Faced with the same situation, different participants could play different roles and perspectives. These individuals' opinions are valued to help the participants to self-reflect on what they have known and may not know. Second, the problems that are described in these learning materials should be relevant to students' interests. According to Merrill's (2002) online course design principles, engaging learners in solving real-world problems that they are interested in could promote learning. Based on the problems that are relevant to students' interests, thirdly, the course needs to address students' suppositions. Fourth, learning is structured around primary concepts. These primary concepts construct the awareness and develop the knowledge about what the participants have already experienced in their real life. At last, students' learning should be assessed in the context of teaching.

In Brewer's (2010) design, the WebQuest was framed around a scenario in which the students take on a role to complete a task, which was based on social and cognitive constructivism. The task asked students to learn more about cyberbullying by viewing multimedia resources on the Internet. Students constructed meaning about cyberbullying and its negative impacts through the Internet as more knowledgeable others. This design echoed with the principle of Merrill (2002). For instance, through varying activities with the core attribute being a whole-task approach representative of the real world as opposed to a deconstructed, topic-centered approach, focusing on simplified task components (problem-centered learning) or through the peer interaction to help learners understand effective application and transfer the knowledge to new situations (demonstration).

According to Wong et al. (2014) and Leung et al. (2019), the online course on the topic of cyberbullying should be age-specific as well as culture-specific. The design of our online course needs to take in suggestions of different stakeholders, which can provide bottom-up information regarding the stakeholders' needs. In addition to the points of view from students, opinions from teachers and social workers who could use this online course as an adjunct to teaching were also needed to be sought and valued. However, to our knowledge, there was no study about anti-cyberbullying

online courses that were grounded from target audiences' opinions and suggestions toward the design.

2.2 Online Course Learning Engagement and Effectiveness

Regarding the course design, both Brewer's (2010) WebQuest course and Leung et al.'s (2019) Moodle course provided detailed design based on design principles or underlying theoretical supports, but we had no idea how the students engaged in an online course about cyberbullying. Although the previous studies indicated the positive learning outcomes that resulted from the online courses, there is a need to better understand the nature of online participants' learning engagement with online courses (Tualaulelei et al., 2021). More specifically, whether the participants engaged with the course as course designers intend should be investigated.

In a recent study, according to the learners' online behavioral learning engagement, Yang and his colleagues (2020) indicated that the learners could be categorized into active learners, passive learners, and achievement-driven learners, whose academic performance had significant differences. However, the participants in this study were college students who were supposed to be self-regulated learners. For younger adolescents, such as primary or secondary students, we did not have any idea how they would navigate the online platforms for the learning that was not required by their curriculum. Furthermore, whether the learning outcomes were associated with the learner's different online behavioral engagement is worth to be investigated.

2.3 Aims of This Study

In this study, based on the literature review, we first investigate the needs of the online course design for the adolescent participants from the perspectives of students, teachers, and social workers who were concerned about cyberbullying issues in Hong Kong. Second, based on the stakeholders-grounded online course design, we aimed to explore the participants' online learning behavioral engagement. Lastly, we aimed to evaluate the effectiveness of the online course in terms of their favorable attitude toward cyberbullying, empathy to cyber victims, and coping skills. Three research questions were guiding this study:

RQ1: What were the needed design features in a self-paced online course on the topic of cyberbullying?

RQ2: How were the adolescents engaging in this self-paced online course based on the grounded design?

RQ3: Does this self-paced online course improve the adolescent's attitude, empathy, and coping skills about cyberbullying issues?

3 Method

This research was designed as an action-oriented case study. In the first study, based on an initial version of an online course, group interviews for students, teachers, and social workers were conducted to investigate the online course design features regarding the topic of anti-cyberbullying for adolescents in Hong Kong. In the second study, an anti-cyberbullying online course was developed and launched for participation based on a voluntary basis. Then, participants' online learning behavioral engagement and learning effectiveness were investigated to inform the further anti-cyberbullying educational programs.

3.1 Participants

In study one, participants were interviewed separately according to their different roles as students, teachers, or social workers. The student groups consisted of 11 primary and secondary school students. The teacher group consisted of two teachers, one primary school teacher with 6 years of teaching experience and one secondary school teacher with 10 years of teaching experience. The social worker group consisted of three social workers who were working on a cyber-wellness project for Hong Kong primary and secondary schools.

In study two, three primary schools in Hong Kong voluntarily participated in the online course. In each school, a certain amount of online course accounts was distributed to students based on the demand of teachers. A total of 1110 accounts were distributed to students. However, on a voluntary basis, 82 primary students enrolled in this course and participated in at least one activity in this course by the end of May in 2021. Since our aim was to investigate the online behavioral learning engagement through participatory data, in order to protect participants and address teachers' concerns on students' personal privacy, we did not collect more detailed background information of the participants than necessary.

3.2 Data Collection

3.2.1 Interviews

The interviews consisted of two parts. First, the interviewees would go through the initial version of the online course individually. The course experiences took 30–60 min. Then, they would respond to the interview questions based on their learning experience in this online course in a group of two to four interviewees. Each interview lasted 30–60 min. The interview questions involved the aspects of (1) comprehension of the course contents, (2) difficulties that experienced, and (3) suggestions on course

design. One example question was ‘were the course materials and activities easy to understand? If not, what was difficult for you?’.

3.2.2 Online Participation Data

For all the online course participants, their participation data and grade were extracted from edX platform. The participation data contained the status of the participation on the activity of introduction, concept card learning, case study, and unit quiz in four units. The status of the participation consisted of ‘never accessed’, ‘accessed but not completed’, and ‘completed’.

3.2.3 Survey Data

The participants’ responses in pre-survey and post-survey were downloaded from Qualtrics platform. The pre-survey and post-survey both consisted of three dimensions:

1. Attitude toward cyberbullying behaviors (Wright & Li, 2013, e.g., If you’re angry, it is OK to spread rumors about other people online).
2. Empathy toward cyber victimization (adapted from Empathetic Responsiveness Questionnaire, Olweus & Endresen, 1998, e.g., When I know someone was hurt by some online messages, I wish to help him/her).
3. Coping skills when they were facing cyberbullying incidents (i.e., seeking helps rather than tolerating the events, such as getting help from a family member).

All the responses for the three dimensions were in 5-point Likert scale style. For attitude and empathy, the response scale was from strongly disagree to strongly agree. For coping skills, the response scale was from never to always. Since these surveys were not compulsory to earn the course certificate, not all the participants would finish all of them.

3.3 Data Analysis

3.3.1 Thematic Analysis

A thematic analysis with constant comparison method was conducted to generate themes and sub-themes from the interviews to answer the first research question in Study 1. First, all the interview transcripts had been gone through by the author. Second, each sentence was coded based on the interviewee’s perceptions, comments, and suggestions regarding the course instructional design and materials. Third, all the coded contents had been gone through again. Those contents with same or similar meaning were merged as one code. Those contents that were only mentioned once

by one interviewee were identified as insignificant codes and removed. Fourth, the remaining coded contents were categorized as one major theme when they were attributed to the same course design feature. The relationships among the constructed themes were linked based on the detailed coded contents in each theme and previous online course studies (Hew, 2016; Lan & Hew, 2020). At last, all the themes and corresponding associations had been gone through again by the author and a research assistant. Any discrepancy was discussed between the author and a research assistant until reaching a final consensus.

3.3.2 k-Means Clustering

A k-means clustering was conducted based on the participants' online behavioral learning engagement in the four components (i.e., the number of completed activities in unit introduction, conceptual learning, case study, and unit quiz) to answer the second research question. The four indicators of the online behavioral learning engagement were standardized before doing the k-means clustering analysis. For each clustering, Bonferroni Post Hoc test was applied to identify any insignificant difference between the clusters regarding the four standardized indicators of online behavioral learning engagement.

3.3.3 Comparative Analysis

To answer the third research question, a Wilcoxon Signed Rank Test was conducted to test the changes of attitude, empathy, and coping skills before and after participating in the online course in full samples as well as in each cluster. Furthermore, a Mann-Whitney U Test was conducted to test the difference between the clusters regarding their changes on attitude, empathy, and coping skills.

4 Results

4.1 Study 1: Investigation of Online Course Design Features

According to the group interviews, different stakeholders' comments and suggestions were categorized into seven features to improve our online course design (see Fig. 1 for the summary). All-important, the course design needs to be attractive. Younger adolescents expected stimulating stories (e.g., story-based learning materials) and games (e.g., game-based learning or gamified activities) to maintain their learning persistence.

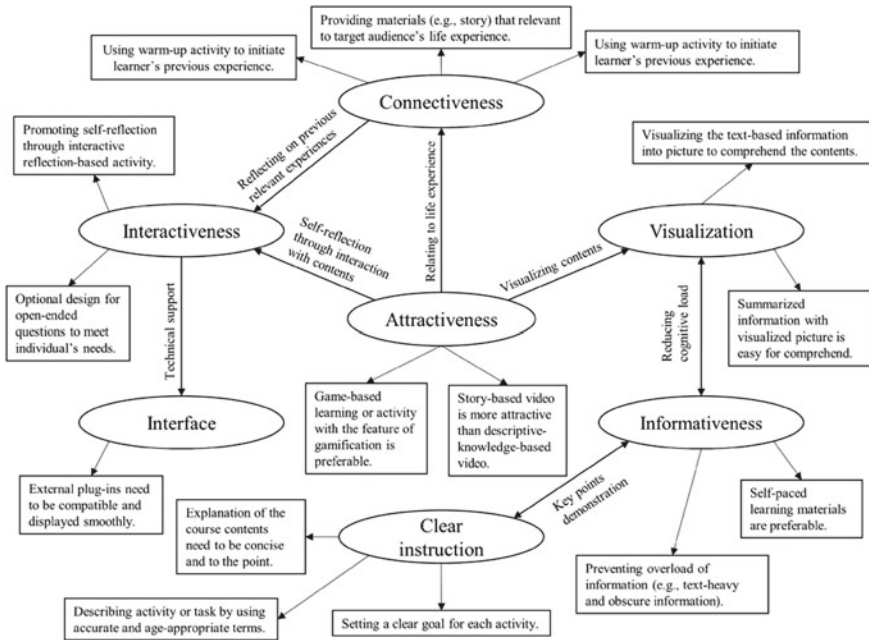


Fig. 1 Summary of online course design features

Three features were highly correlated with the feature of attractiveness. The first feature is visualization, which refers to text-based information being visualized into pictures or videos, which could facilitate young students' comprehension of the contents in an intuitional way. The second is connectiveness, which means the learning materials and contents were most relevant to students' life experiences in order to raise their awareness about their previous experience. The third feature is interactiveness, i.e., the presence of effective-interactive activities to promote students' self-reflections, even though the interactions were between content and learner.

Regarding the feature of visualization, stakeholders intended to go through the acceptable information load and control their own learning pace. Moreover, based on the appropriate informativeness, the learning contents should be clearly demonstrated in terms of their aims of activities and the key points that they tried to deliver, namely clear instruction.

Except for the design of content, the platform of edX was commented as less user-friendly for younger adolescents. In particular, the activity that needs external plug-ins (e.g., the activity component that need additional technical supports) could reduce the smoothness of navigation and activity participation.

4.2 Study 2: Course Development and Evaluation

According to the summary of the online course design features in Study 1, we further developed our anti-cyberbullying online course in terms of overall features and the components of unit introduction, conceptual learning, case studies, and unit quiz (see Table 1 for the course revision).

After the course development, this anti-cyberbullying online course was officially launched for Hong Kong primary and secondary schools to participate on a voluntary basis through a school cyber-wellness ambassador program. The following sections demonstrated the results about the participants' online behavioral learning engagement and learning effectiveness regarding the changes in attitude, empathy, and coping skills.

Table 1 Course revision

Components	Revision on course design
Overall	To motivate the participants doing the activities in this anti-cyberbullying online course, we created a leaderboard to demonstrate the learning progress of each participant. The participants can lighten up the stars on the leaderboard through completing activities in each unit. To clarify the required activities for completion, we created a completion button at the bottom of each required activity. Moreover, a green tick mark will be shown automatically beside the title of each activity when the participants complete the activity
Unit introduction	To connect the learning of this course with participants' previous experience, we created a set of warm-up activities in each unit introduction component. For instance, we created a poll for participants to vote whether they have experiences in a list of situations. The situation was described based on the real cases that were provided by social workers who were working on a cyber wellness program in Hong Kong
Conceptual learning	To prevent information overload that results from the text-heavy learning materials, we converted almost all the text-based knowledge into images or videos. However, some key conceptual contents that we intend our participants to learn, we kept them next to the visualized images. In addition, for each visualized content, it will contain a mini-story based on a real case that the participants may encounter
Case studies	To promote participants' self-reflection about cyberbullying incidents from different roles (i.e., bully, victim, and bystander), we created the case study materials (e.g., case description through comics, and self-reported rating on their assumptive behaviors, emotions, and coping skills through role-playing) based on the real cases from school social workers
Unit quiz	We created unit quizzes to assess the participants' understanding about the conceptual knowledge that were relevant to the learning outcomes (i.e., understanding the concept of cyberbullying, identifying the types of cyberbullying behaviors, realizing the negative consequences from cyberbullying issues, and learn to deal with cyberbullying incidents). These quizzes were described based on real cases from school social workers or News

4.2.1 Online Behavioral Learning Engagement

Applying the k-means clustering analysis, the students were divided into two groups to five groups. The maximum number of groups for the analysis was limited to five, because a non-representative small group (i.e., the number of participants in this group was below 5) would be separated with the number of groups increasing.

All the clustering—two-group to five-group—achieved convergence. However, Bonferroni Post Hoc tests indicated that, regarding the four-group clustering, cluster 2 and cluster 4 were not significant different in terms of the participants’ behavioral engagement in the conceptual learning session (i.e., the number of conceptual cards learned, mean difference (cluster 2 – cluster 4) = -0.24 , $STD = 0.16$, $p = 0.799$); and cluster 3 and cluster 4 were not significant different in terms of the participants’ completion in unit quiz session (i.e., the number of quizzes completed, mean difference (cluster 3 – cluster 4) = -0.06 , $STD = 0.11$, $p = 1$). Regarding the five-group clustering, Bonferroni Post Hoc tests indicated that cluster 2 and cluster 5 were not significant different in terms of the participants’ behavioral engagement in the conceptual learning session (mean difference (cluster 2 – cluster 5) = -0.25 , $STD = 0.12$, $p = 0.374$); and cluster 1 and cluster 4 were not significant different in terms of the participants’ completion in unit quiz session (mean difference (cluster 1 – cluster 4) = -0.35 , $STD = 0.18$, $p = 0.498$). Compared to two-group clustering, three-group clustering could provide more information about how these participants engaged in this anti-cyberbullying online course. Therefore, the following results were presented based on three-group clustering.

The three identified clusters showed different levels of online behavioral learning engagement in each component of each unit (see Fig. 2). Bonferroni Post Hoc tests indicated that the three clusters significantly differed on their completion of activities in unit introduction component, conceptual contents learning component, case study component, and unit quiz component.

The cluster 1 comprised 21 participants. They had the lowest learning engagement in this online course based on their completion rate in each activity component of each unit. They completed some activities in the opening units but gradually dropped out as the course progressed. None of these participants took the final assessment. Therefore, the participants in this cluster were named as *Dropouts*.

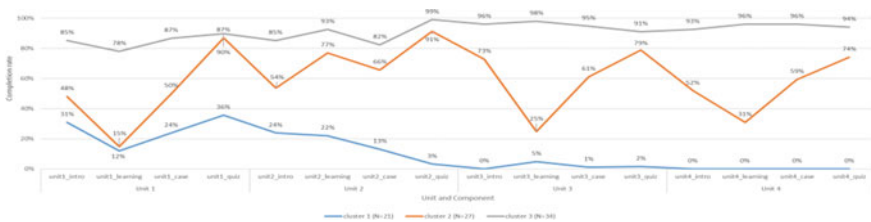


Fig. 2 Completion rates on each component in each unit based on three clusters

The cluster 2 comprised 27 participants. They selectively engaged in the course activities, which they had much lower engagement in static learning materials (e.g., concept cards) but had higher engagement in interactive learning materials (e.g., self-reflective case study and unit quiz). Over 81% (N = 22) of these participants took the final assessment. Since these participants preferred to do activities that required responses, they were named as *Responders*.

The cluster 3 comprised 34 participants. They are highly engaged in each activity component of this course. The average completion rate for each component was from 78 to 99%. Almost everyone in this cluster (N = 33) took the final assessment, so they were named as *All-rounders*.

An independent-samples t-test was conducted to compare the final assessment attempted ratio for the *Responders* and the *All-rounders*. There was no significant difference in the attempted ratio for the *Responders* (M = 0.80, SD = 0.25) and the *All-rounders* (M = 0.88, SD = 0.21; $t(53) = -1.37, p = 0.18$, two-tailed).

4.2.2 Learning Effectiveness

There were 24 learners who completed both pre-survey and post-survey regarding their attitude toward cyberbullying (five items, total max score = 25), empathy toward cyber victimization (three items, total max score = 15), and coping skills for seeking helps (three items, total max score = 15). Seven participants were identified as non-serious answers, because their responses on all the items were the same. After removing these non-serious answers, the data from 17 participants were analyzed as below. Thereinto, six participants were Responders (i.e., cluster 2 participants) and eleven were All-rounders (i.e., cluster 3 participants, see Table 2 for descriptive statistics).

For all samples, a Wilcoxon Signed Rank Test revealed no statistically significant changes (i.e., differences between the post-survey score and the pre-survey score) regarding the participants’ attitude ($z = -0.492, p = 0.623$), empathy ($z = -0.382, p = 0.702$), and coping skills ($z = -1.370, p = 0.171$) in this anti-cyberbullying online course.

Table 2 Descriptive statistics on attitude, empathy, and coping skill

		Cluster 2 (N = 6)			Cluster 3 (N = 11)			Total (N = 17)		
		Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Attitude	Pre	9.33	3.56	8.00	6.00	1.67	5.00	7.18	2.90	6.00
	Post	10.50	6.75	8.00	6.36	2.25	5.00	7.82	4.64	5.00
Empathy	Pre	11.17	1.47	11.50	12.82	2.32	13.00	12.24	2.17	12.00
	Post	12.33	2.16	12.50	12.55	0.93	12.00	12.47	1.42	12.00
Coping skill	Pre	6.00	2.19	6.50	10.45	2.98	11.00	8.88	3.44	9.00
	Post	9.17	2.71	9.50	10.27	2.49	10.00	9.88	2.55	10.00

For Cluster 2—Responders, the Wilcoxon Signed Rank Test revealed a statistically significant increase in the coping skill after learning this anti-cyberbullying online course, $z = -2.214, p = 0.027$, with a large effect size ($r = 0.90$). The median score on the coping skill scale increased from pre-survey ($Md = 6.50$) to post-survey ($Md = 9.50$). There were no statistically significant changes regarding attitude ($z = -0.315, p = 0.752$) and empathy ($z = -1.511, p = 0.131$) in cluster 2.

For Cluster 3—All-rounders, the Wilcoxon Signed Rank Test revealed no statistically significant changes from pre-survey to post-survey on attitude ($z = -0.340, p = 0.734$), empathy ($z = -0.420, p = 0.674$), and coping skills ($z = -0.239, p = 0.811$).

A Mann–Whitney U Test revealed a statistically significant difference in the changes regarding coping skills of Responders ($Md = 3.00, N = 6$) and All-rounders ($Md = 0.00, N = 11$), $U = 9.50, z = -2.375, p = 0.015, r = 0.58$. The Mann–Whitney revealed no significant difference in the changes in terms of attitude toward anti-cyberbullying of Responders ($Md = -1.00, N = 6$) and All-rounders ($Md = 0.00, N = 11$), $U = 32.50, z = -0.051, p = 0.961, r = 0.01$. There was also no significant difference in the changes regarding empathy toward cyber victimization of Responders ($Md = 1.00, N = 6$) and All-rounders ($Md = -1.00, N = 11$), $U = 17.00, z = -1.631, p = 0.122, r = 0.40$.

5 Discussion

5.1 *Attractiveness: The Threshold of a Self-paced Online Course*

Unlike previous studies of the top-down course design for anti-cyberbullying (Brewer, 2010; Leung et al., 2019), a self-paced online course was developed based on different stakeholders' involvement (i.e., students, teachers, and social workers) during the course design phase. The stakeholders' opinions, comments and suggestions regarding course design and course materials were taken into account through interviews. According to the interviewees, for the non-compulsory learning about anti-cyberbullying, attractiveness is the first element in the course design. Three relevant features are directly associated with the attractiveness—connectiveness, interactiveness, and visualization, which informed us on the design of a self-paced online course. According to the online course design principle (Merrill, 2002), many researchers (Hew, 2016; Leung et al., 2019) promoted the problem-centered learning strategies as a factor that could enhance the online learning (e.g., MOOCs). Based on a problem, such as cyberbullying, online learners connect what they perceived or learned from the online course to what they experienced before in a similar situation. In such a way, learners were stimulated and engaged to solve potential daily life problems that they may concern. The most effective stimulation was promoting the self-reflection of the participants through interacting with the contents that were

structured around basic concepts. When the problems are described to be relevant to students' daily life, they may have a higher sense of relatedness to connect the basic concepts to what they were experiencing regarding the same or similar problem (e.g., cyberbullying). Then, when the learners try to interact with the contents (e.g., make decisions on an understanding or a situation), they could perceive more competence for the learning because they comprehended more about the situation from the perspective of self. In other words, according to Merrill (2002) and Margaryan et al. (2015), we need to take the features of activation as well as integration into the course design through the authentic resources. To robust the connectiveness and interactiveness for attractiveness, visualizing the information is a have-to-do process. According to the cognitive theory of multimedia learning (Mayer, 2005), the visualized information demonstrated to the learners the contents in a more vivid way that required lower cognitive load, as well as provided clear instructions to reduce learners' confusion, especially for the younger adolescents.

5.2 *Interactiveness: The Core Feature to Engage Learners*

In terms of online behavioral learning engagement, consistent with the results of previous online learning studies (Yang et al., 2020), we also found three types of online learners, i.e., Dropouts—passive learners, Responders—achievement-driven learners, and All-rounders—active learners. There was no doubt that the dropouts had the lowest academic performance regarding the final assessment attempted ratio (i.e., none of these participants took the final assessment). However, unlike the results of Yang et al. (2020), we did not find that the Responders and All-rounders had significant academic performance differences regarding the final assessment attempted ratio. The design of only one set of final assessments could be one possible reason that explains the in-significant differences, because participants can skip all the activities and only do the final assessment for those who are only concerned about passing the assessment. In our study, we did not find those responders skip all the activities. Instead, they also had high engagement in those activities with the feature of interactiveness (i.e., the participants need to make decisions or select the options for a situation). We know that these *Responders* were not passively receiving the learning materials. They had the need for perceived competence to make choices based on what they had learned. Regarding the *dropouts*, we did not have any other data to do more exploration on why they did not persist on the learning. In the future study, we may collect the qualitative data (e.g., individual interviews) as additional information to do the investigation on these *Dropouts*.

5.3 Effectiveness: Unsolved Puzzle

Previous studies (Brewer, 2010; Leung et al., 2019) indicated the positive effect of anti-cyberbullying online courses for increasing students' awareness and knowledge. In this study, we further explored the effects of anti-cyberbullying online courses for the change of students' attitude, empathy, and coping skills toward cyberbullying incidents. Based on the small sample size, we did not find the significant effect. Even though the course was separated into different units that can be accessed on a weekly basis, the majority of the participants would do the course at once to finish all the activities. Based on such a short learning duration, the course may not have a substantive effectiveness on changing the students' attitude and empathy that may require a long-term intervention, which need more measures from families, schools, and society. However, in terms of coping skills, the Responders had a significant positive change (i.e., incline to seek help from others other than passively deal with it independently) than All-rounders. On the one hand, coping skills were more intuitive information that the participants could quickly receive based on short-term learning. On the other hand, the Responders may be learners who lack skills on handling cyberbullying incidents, and the intuitive contents regarding coping skills could help these participants to do a quick knowledge construction. All-rounders who are actively engaged in this online course may already be those who had lower tolerance attitudes toward cyberbullying behaviors, higher empathy toward cyberbullying victims, and were more capable to handle cyberbullying incidents. The online course could consolidate their knowledge rather than making a difference. In the future study, we can explore the long-term effectiveness of this online course on the participants' changes on attitude and empathy. In addition, how this online course could be integrated into an anti-cyberbullying program in a broader social condition could be investigated. Furthermore, who may need more help on anti-cyberbullying should be identified.

6 Conclusions

With the increase of cyberbullying problems, we need to increase the awareness and knowledge about cyberbullying issues for adolescents. A self-paced online course was an approach to raise adolescents' awareness and develop their knowledge about cyberbullying issues. Nevertheless, for this kind of non-compulsory learning, to increase their learning engagement, the design of the activities should be succinct and contain visualized, intuitionistic, and interactive contents. In addition, we suggested appropriate teachers' monitoring for the younger students' self-paced online learning, which can ensure their learning quality. However, the long-term effectiveness for changes in attitude and empathy merely through a self-paced online course is yet to be evaluated in future studies.

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Language Learning and Teaching

Teaching in the Time of Corona(Virus): A Cross-Institutional Study of Online English Language Teaching in Hong Kong Higher Education



Noble Po Kan Lo and Sumie Chan

Abstract This research is aimed at establishing how teaching culture has been transformed by the implementation of online teaching and learning during the COVID-19 pandemic crisis. In particular, the study evaluates how this paradigmatic shift towards online learning has impacted the teaching culture of Hong Kong from the perspective of teachers working in higher education who have moved to teaching online. This overarching research objective is pursued through investigating the impact of online learning from within the theoretical frameworks of both Education and Media Psychology, examining how the new media employed in online teaching can transform teaching through its mediation between teacher and learner from an interdisciplinary perspective.

Keywords Online English language teaching · Online education · Positive psychology

1 Introduction

This paper analyses the impact of online teaching using the perspectival lens of positive media psychology, examining how this application of new media is transforming the experiences of teachers and how it may be leveraged to improve the well-being of students now learning online. Several core questions were answered over the course of this research including: how is online teaching affecting the experience and well-being of teachers; how may any negative impacts be offset; and in what ways can benefits be maximised and enhanced by the implementation of new

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media in teaching? These questions are explored in this study through the undertaking of both primary and secondary research. The study introduces the contextual background to the topic considering the implementation of online teaching in the wake of the COVID-19 pandemic from both a global perspective and that of higher education in Hong Kong. This is followed by a review of the literature on online education, applying an interdisciplinary approach to present a synthesis of literature from within the Education field and a positive psychology approach to Media Psychology. The primary data analysed during this study is comprised of both questionnaire and interview data derived from students of English Language learning online at higher education institutions across Hong Kong. This variety of primary questionnaire and interview data allows for both quantitative and qualitative analyses and the triangulation of findings across both sources. The survey evidence was analysed by applying appropriate statistical and quantitative techniques, whilst an analytical thematic coding approach was applied to the critical review of interview responses. This research has found that online teaching can be leveraged to improve the well-being of students following the paradigmatic shift towards online teaching and learning as precipitated by the COVID-19 pandemic crisis.

1.1 Research Background

The unprecedented and disruptive effects of the 2020 Covid-19 pandemic have shocked and transformed the global higher education industry as digital, remote learning solutions have emerged in the wake of quarantines, lockdowns, and closures (Oraif & Elyas, 2021). For faculty members, this transition means a shift in pedagogical tools, techniques, and strategies as educators have shifted their classrooms from traditional, face-to-face education to online, geographically distant digital solutions (Daumiller et al., 2021). This strategy of proactive pandemic coping has involved the introduction of the massive open online course (MOOC) which combines students of varying backgrounds, geographies, and experience levels into a singular pursuit of curricular achievement (Anderson et al., 2020). In Hong Kong, a city that has initiated her exploration of digital learning as early as 2018, the technological shift towards online learning solutions was efficient and structurally anticipated (Lau et al., 2020). However, for students and teachers, evidence from prior research in this field (Marshall & Wolanskyj-Spinner, 2020; Oraif & Elays, 2021; Rahman, 2020) reveals varied experiences, behavioural challenges, and adaptive limitations. Accordingly, this research adopts a positive psychological approach to analyse student experiences in online tertiary education following the 2020 global pandemic and to assess the impacts of the technological shift towards online learning in higher education.

1.2 Research Aim and Objectives

The primary aim of this study is to critically assess the effects of Covid-19 on a paradigmatic shift towards online learning and the influences on higher education teaching strategies in Hong Kong. In accomplishing this research aim, the following core objectives have been pursued:

- To critically discuss the mediative effects of online technologies in shaping the teacher–student relationship.
- To assess the role of new media employed in online teaching on teacher culture and behaviour in Hong Kong higher education.
- To analyse productive learning strategies and student experiences to identify opportunities for improving virtual learning in the future.
- To highlight critical areas of opportunity for refocusing and supporting teacher strategies designed to improve student learning experiences in virtual learning.

1.3 Research Questions

Several core research questions that have been answered over the course of this study:

1. What are the primary forces shaping new media learning in modern higher education classrooms?
2. What role has Covid-19 played in transitioning Hong Kong higher education towards online learning solutions?
3. How has new technology altered teaching and learning experiences and created new behaviours amongst teachers and students with reference to English learning in different contexts in higher education?
4. How may negative impacts be offset; and in what ways can benefits be maximised and enhanced by the implementation of new media in teaching?

1.4 Research Overview

This chapter has provided an in-depth overview of the core aim and objective of this study and outlined the central research questions that were answered during this mixed methods process. The remainder of this paper will progress from a general overview of academic theories and core concepts related to virtual learning experiences to a targeted, positive psychological review of student experiences in Hong Kong virtual learning. Finally, this study will offer recommendations for improving teacher–student relationships and maximising the effectiveness of virtual learning environments in the future.

2 Literature Review

2.1 Introduction

The unprecedented impacts of Covid-19 have facilitated a radical shift in higher education, and as a result, diversified the focus of research in this field of study. By combining teaching strategies with student perceptions of virtual learning, the following sections will comparatively review the extant literature in this field. Key insights related to improving the learning experience and maximising teacher effectiveness are introduced as core themes in the subsequent empirical research.

2.2 *Virtual Learning and New Media, a Teaching Perspective*

For educators, the “online delivery of courses with work-at-home protocols and ubiquitous online work-related activity creates a lack of physical, temporal, and/or psychological boundaries between school and home” (MacIntyre et al., 2020, p. 1). To cope with such pressures, MacIntyre et al. (2020) observes that teachers develop either approach (e.g., acceptance, support, planning, active coping) or avoidant (e.g., disengagement, denial, blaming, venting) strategies that moderate their productive or unproductive responses. Whilst positive, approach-based coping mechanisms are desirable, Gao and Zhang (2020) remind that the recent pandemic was both sudden and disruptive, resulting in skills, awareness, and experience gaps that affected teacher behaviour and stress management practices. Whereby educators are increasingly proficient with ICT resources, the emphasis on pedagogical and content-specific knowledge resources has limited the translation of these course-based skills into digital and technological solutions to the pressures and stresses of online teaching (Gao & Zhang, 2020; Jiang et al., 2020; Wang et al., 2020). The underlying modality for effective online education involves distinct, techno-social skills which Jiang et al. (2020) argue must be transferred to teaching professionals to support more positive pedagogical responses in the virtual classroom.

The virtual teaching environment subjects students to a disconnected position, distancing their involvement via technological, module, and communicative barriers (Kim & Asbury, 2020). To overcome such constraints, Halim (2021, p. 92) reports on the innovative strategies adopted by an English language teacher in order to ensure that the “teaching was not dull” by adopting scaffolding techniques and interactive communication strategies to improve the virtual experience. Through virtual, synchronised classroom discussions to self-paced learning resources to intra-classroom collaboration and discourse, multimedia virtualisation of the learning process requires integrated solutions that are application-mediated, but socially engaging (Halim, 2021). Whilst integrative activities and engaging content materials may encourage some students to participate productively in the learning process, Yandell (2020) reminds that the heterogeneity of technological, material, and

metacognitive resources possessed by these students means that accommodation and adaptation must be integrated into the teaching modalities. By incorporating various 'breakout rooms', establishing question and answer (Q&A) support procedures, and developing multimedia PowerPoint presentations, Moorhouse (2020, p. 610) recognises that virtual teaching is about adaptive and responsive solution-finding regardless of technological hurdles.

2.3 Student Skills, Competencies, and Challenges in Digital Education

Central to understanding the effects of virtual learning environments on student behaviour, researchers (e.g., Weber & Ahn, 2021; Yu et al., 2010) have recently drawn on social learning theory to explain behavioural mirroring, reinforcement, and self-efficacy. Bandura's (1977) conceptualisation of social learning hypothesises that individuals learn behaviours and engage with peers to self-regulate their learning behaviours in order to achieve positive outcomes. Yu et al. (2010) recognise that through social networking, intranets, and online discourse, students are able to develop new skill sets that not only improve their online learning capabilities, but their capacity as students overall. Drawing upon this theory of learning effects, Weber and Ahn (2021, p. 115) observe that if effective, virtual learning environments "provide learners meaningful interactions with their professions and peers, foster a culture of learning, and support multiple learning styles". The problem with this applied theory in virtual environments is that Bandura (1977) predicts a need for social interaction in order to stimulate and reinforce associated behaviours. With universities continuing to adopt the MOOC format of online education, Anderson et al. (2020) confirm empirically that only those students who participate in group exercises and discussions gain access to the developmental skills and social support necessary to improve their overall learning experience.

As communities of practice (CoPs), social linkages across digital channels allow students to actively engage in information seeking, sharing, and discussion via remote portals (e.g., chat rooms, intranet), video chat (e.g., zoom), and interactive experiences (e.g., gaming, creative activities) (Anderson et al., 2020). As students have been exposed to heightened pressures in unfamiliar, virtual education systems, Marshall and Wolanskyj-Spinner (2020) suggest that network-based stress management and support solutions are critical to improving student coping measures and developing strategies for managing emotional and social pressures. Rahman (2020) reports that due to deficiencies in self-regulatory behaviours and student motivations, the effectiveness of the learning experience and the discipline of the virtual classrooms can inhibit educational productivity. By targeting improved student motivation, stimulating active learning experiences, and developing communication solutions that support individual student needs, Daumiller et al. (2021) argue that the risk of student burnout and heightened performative stress can be systematically diluted.

It is the pursuit of familiarity and meaningful experience which Oraif and Elyas (2021) suggest not only elevates student-self regulatory behaviour, but also creates conditions through which teachers can engage more productively with their student population.

2.4 Summary

The disruptive impacts of Covid-19 require a degree of student and educator resiliency that often conflict with personal, technological, and systemic capabilities. From environmental influences to time management, digital identity-shaping and the incongruous effects of virtual learning during the pandemic on student–teacher experiences reveal the need for additional research regarding specific, positive coping and supporting strategies. The following chapter outlines the methods that were deployed to assess the experiences of Hong Kong students thrust into virtual learning during the pandemic since 2020.

3 Research Methodology

3.1 Introduction

The scope of research surrounding teacher pedagogy and tactics is broad, encompassing a breadth of both social and scientific studies that endeavour to interpret behaviours according to their situational and causal conditions. The current investigation has adopted a pragmatic perspective, applying a positive psychological philosophy to the collection and interpretation of both primary and secondary evidence relate to the effects of Covid-19 on the technological shift towards online learning in higher education studies. The following sections outline the justification for this approach and highlight the sources of evidence collected over the course of this study of mixed methods.

3.2 Research Paradigm

Distinct from the conventions of traditional, pathology-based psychology, a positive psychological paradigm represents the “science and applications related to the study of psychological strengths and positive emotions” (Snyder et al., 2011, p. 18). Derived from social constructions and socio-cultural interpretations, this approach explores the positive contagion forces which shape, sustain, and project health and productive outcomes (Snyder et al., 2011). By focusing on theoretical

constructs such as self-determination theory, intrinsic motivation, emotional intelligence, creativity, and quality of life, positive psychology extrapolates strengths and patterns of positivity from both good and bad scenarios to refocus cognitive processes on healthy and productive solutions (Carr, 2013). Whereby Gable and Haidt (2005, p. 104) attribute the positive psychological philosophy to patterns which allow “flourishing or optimal functioning”, when applied to empirical research, Sheldon and King (2001, p. 216) argue that the conventions of positive psychology are innately embedded in the study of “ordinary human strengths and virtues”. Accordingly, this study was designed to emphasise the positive, productive, and contributory roles of technological immersion and pedagogy in modern higher educational settings.

3.3 Research Approach

Underscoring the design of this study was an initial revelation that positive psychology provides a “different lens through which to understand human experience”, deriving a shared language, shared interpretation, and shared understanding from the comparative revelations of the research subjects (Linley et al., 2006, p. 7). Operationalising such comparative pursuits, pragmatism represents a pursuit of causal linkages between both situational triggers and behavioural influences, addressing both the causes and effects of positive empirical outcomes (Morgan, 2014). Accordingly, this study has combined both quantitative and qualitative methods into a single, pragmatic, mixed methods approach to social research that seeks to construct understandings of student experiences with virtual learning from a positive, adaptive perspective of future technological integration (Creswell & Clark, 2017). The quantitative instrument applied to this study is characterised by several targeted sections that were thematically extrapolated from the prior literature in this field:

- Section 1: Demographic Overview: A series of scalar prompts designed to group the participants according to key personal identifiers (e.g., gender, education level) and experiential patterns (e.g., class numbers, contact hours).
- Section 2: Technological Overview: A review of technologies, behaviours, and practices employed during the pandemic and its remote learning expectations.
- Section 3: Online Learning Overview: An assessment of student perceptions regarding online learning before and after Covid-19 using varying 5-point Likert scales to assess opinions and perceptions.

The survey was administered remotely using GoogleDocs and employed a dedicated, internal link within the Hong Kong educational system to encourage participation. Participants include students who are currently reading for associate degrees, undergraduate programmes or postgraduate programmes in Hong Kong. This is a university-wide research project in which data collected from the survey includes students from The University of Hong Kong, The Chinese University of Hong Kong, The Hong Kong University of Science and Technology, The Hong Kong

Polytechnic University, The City University of Hong Kong, The Hong Kong Baptist University, and The Open University of Hong Kong. Once the survey results had been collected, additional evidence regarding post-Covid-19 learning experiences was supplemented by secondary sources including academic journals and industry reports. These secondary results were predominately qualitative and designed not only to interpret the effects of the global pandemic on higher learning education patterns, but also forecast the future of digital learning technologies in the educational system in Hong Kong and its world impacts.

3.4 Sampling and Participant Selection

To narrow the results captured over the course of this study and focus on student experiences, a non-probabilistic, purposive sampling approach was initially adopted (Bryman, 2015). This approach involved establishing several overarching inclusion criteria including student status (active), online education experience (ongoing), course specifics (English Language) and geography (Hong Kong). Subsequently an opportunistic approach was employed to contact students from a variety of higher education institutions in Hong Kong with courses in English Language as the major medium of instruction. The initial target for this study was established ranging from 200 to 300 participants. A large degree of participation was recorded from the 380 query letters distributed across different online channels, with a total sample of 176 participants (58.7%) completing the survey over the two-month administration period.

3.5 Data Analysis

The results were aggregated using online instruments, summarised in GoogleDocs, and then downloaded into Microsoft Excel to normalise and group the prompts for both visual and statistical analysis. Using various graphing models, visual comparisons of the participant results provided a baseline comparison of means that could be used to interpret groups biases and overarching consensus (Bryman, 2015). Subsequently the software SPSS was also used to conduct statistical comparisons of these weighted means by comparing independent variables (e.g., demographic and experience factors) with dependent variables (e.g., online learning experiences). Singh (2007) recommends a one-way ANOVA comparison of means for administering these comparative tests, resulting in an output of statistical significance (P) that reflects the weighted degree of the quantitative relationship. Crosstabular comparisons were subsequently used to explain these relationships and confirm the significance of the weighted groupings in relation to the virtual classroom transformation.

3.6 Ethical Concerns

This study has critically assessed the perceptions of a diversified population of current students from the tertiary sector in Hong Kong. An array of ethical concerns and risks were observed before administering this survey including exposure and criticism if feedback was revealed to university officials. Accordingly, Punch (2014) recognises that ethical integrity is essential to protect participants from harm (non-maleficence), generating beneficial and objective results (beneficence), and ensuring the fairness of the interpretations. For this study, informed consent was obtained from the participants via the digital link itself that outlined the purpose of the study and the protections that were afforded to each participant (Hammersley and Trainou, 2015). Specifically, such protections included anonymity throughout the process and an at-will survey that could be exited at any time if the questions were deemed unfair or inappropriate (Babbie, 2015).

3.7 Summary

This chapter has outlined the application of the positive psychological approach to a mixed methods study of students' learning experiences in English Language acquisition as a second language in higher education. Through the triangulation of these mixed methods results with the underlying academic theories and emergent intra-industry insights, this research offers a comprehensive overview of the transformative effects of classroom virtualisation and online learning. The following presents these findings in their entirety and discusses their significance relative to the core objectives and overarching focus of this study.

4 Data Presentation and Findings

4.1 Introduction

By adopting a positive psychological approach to this study, the primary objective in surveying these tertiary students was to illuminate the positive behaviours and experiences with reference to virtual learning during this complex pandemic period. These findings combined with an overview of the transition from traditional to virtual learning practices in Hong Kong is combined to highlight the transformative effects and influences of a new paradigm in higher education. The following sections demonstrate the triangulation of the evidence with the core concepts and theories in this field to illuminate a positive pathway towards the progression of digital teaching and learning experiences as a game changer.

4.2 *Overview of Online Learning in Hong Kong*

In 2018, Hong Kong education officials introduced Responsive4U, a “blended learning experiment amongst four local universities” that enabled students to take for-credit courses administered via a combination of online and in-person classes (Lau, 2020, p. 1). By 2020, the programme had expanded to encompass 11 courses which had been attended by 2,000 students (Lau, 2020). With a budget expected to eclipse HKD\$781.2 million for the three-year programme (2019–2022), the anticipatory experiment proved visionary at the start of the 2020 pandemic, establishing the model for transitioning Hong Kong’s higher education into a remote learning sphere (Lau, 2020). Inside programme feedback predicts that following the success of the intra-pandemic response, hybrid or flexible education programmes which combine both online and offline courses will be expanded as structural and temporal barriers are gradually eliminated from the higher education practice (Lau, 2020). Through innovative technologies such as an artificial intelligence (AI) chatbot, instructors are able to field questions from thousands of students without requiring on-demand responses, improving downstream communication efficiency, and providing support to students in the event of uncertainty or concern (Lau, 2020).

Despite the potential advantages of programmes like Responsive4U, a recent assessment of student experiences with digital education conducted by Xiong et al. (2020) revealed a very low satisfaction rate (just 27%) across more than 1,200 responses from students at eight public universities in Hong Kong. Critical of the online learning experience, student feedback suggested that online learning effectiveness was lower than face-to-face, whilst more than 54% indicated that their study time efficiency was negatively effected by the virtual environment (Xiong et al., 2020). Central to such problems were an array of concerns, with a lack of self-discipline (60%) and a poor learning atmosphere (56%) receiving the majority of the responses from these virtual learning students (Xiong et al., 2020). Academic research in this field conducted by Wang et al. (2019) has demonstrated that the likelihood of student distraction in online environments is greater, creating barriers to effective study habits and information retention. Whilst, at the same time, Hong Kong educators have reported that hand’s-on and face-to-face learning are especially essential for some specific programmes in higher educational levels (e.g., clinical studies, medicine, speech pathology (Matchar, 2020).

With inside feedback from university educators across Hong Kong institutions suggesting that virtual learning will undoubtedly remain a part of the educational experience moving forward, the digital revolution continues to challenge normative paradigm of learning and online interaction (Matchar, 2020). By refocusing teaching curriculum and content, instructors have adapted to Zoom-based and virtual meeting sessions, encouraging students to engage in more productive work habits to maintain programme momentum (Lau et al., 2020). Lecturers are equally challenged, often-times recording multiple videos and distributing content virtually without the advantages of face-to-face assessments, interactions, and communication (Lau et al., 2020). By adopting new strategies for developing and sustaining rapport with students, Lau

Programme Undertaking

176 responses

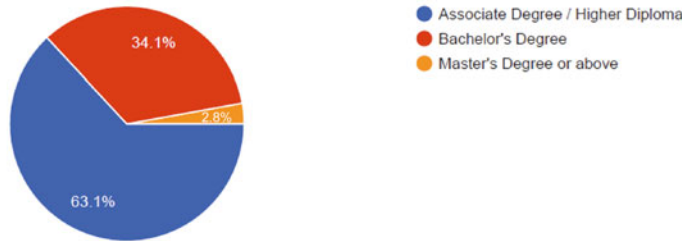


Fig. 1 Programme undertaking

et al., (2020, p. 1) report that instructors are transitioning otherwise “boring and difficult subjects” towards more positive, productive virtual solutions for resilient students engaged in intra-pandemic growth and education.

4.3 Survey Findings

The following sections analyse the results of the quantitative survey, critically comparing key perspectives offered by these university students in Hong Kong from 2020 to 2021 in order to assess their digital learning experiences and competency (both positive and negative).

4.3.1 Demographic Overview

The initial prompts forming the basis for the independent variables were demographic or experiential. For example, the gender bias in this study was equitable with 52% of the participants identifying as male and 48% identifying as female. There was a substantial bias in the age range, with 98.3% between the ages of 18 and 30, a predictable response for a sampling of university students. From a programme perspective, Fig. 1 visualises the weighted distribution, with 63.1% of the participants pursuing their Associate Degree or Higher Diploma and an additional 34.1% pursuing their Bachelor’s Degree.

4.3.2 Online Learning Overview

Given the suddenness of the 2020 pandemic, 61.4% of the students reported that they had not received any training or support for using virtual classrooms prior to their

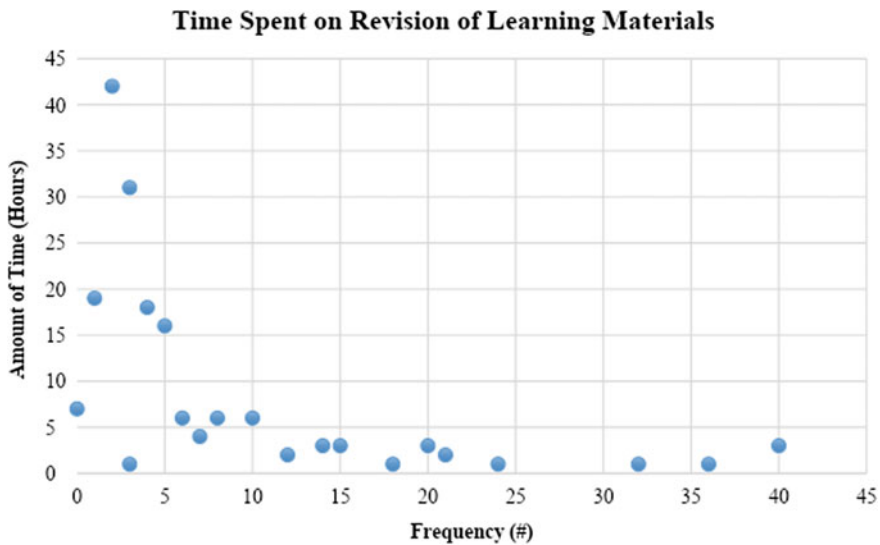


Fig. 2 Time spent on revision of learning materials

initial attendance. Amongst those students (38.6%) who did receive support, step-by-step directions and virtual instructions were the most common modes of preparation and training. Figure 2 summarises the perceptions of the quality of training or support received by these students for online learning, whereby just 28.9% found such training good or excellent, whilst the majority (49.4%) identified the training as average.

To assess the effectiveness of digital learning on student experiences, comparisons were drawn between before and after-effects of this learning process. For the perceived efficacy of the online learning environment before and after Covid-19, respectively, the change in mean response from 3.02 before Covid-19 to 3.19 after Covid-19 suggests that there was improvement in the general belief that the online learning environment was believed to be effective.

A second set of prompts evaluated the perceived effectiveness of assessment before and after Covid-19. With a pre-Covid-19 mean of 3.08 and a post-Covid-mean of 3.23, these findings confirmed that student perceptions of effectiveness were higher following Covid-19 experiences. An ANOVA comparison of means revealed a statistically significant relationship between the After-Covid-19 perceptions of assessment and classroom size ($F = 7.442, P = 0.000$). Crosstabular analysis revealed that participants in smaller courses were most likely to find online assessment effective, whilst participants in larger courses felt more ambiguously about such assessment practices. A statistically significant relationship with Gender ($F = 3.956, P = 0.048$) was also observed in relation to after-Covid-19 assessment. Crosstabular analysis revealed that male students (30.8%) were less likely to find assessment to be effective or very effective than their female (45.2%) counterparts.

By comparing the pre- and post-covid perceptions regarding online as the new learning mode with a pre-Covid-19 mean of 3.31 and a post-Covid-19 mean of 3.27, these findings reveal that the attitude towards online learning declined during this period. In fact, 19.3% of the participants opposed to online learning after Covid-19 as compared to 13.1% before the transition.

Just 30.1% of the students felt that online learning for the upcoming semester would be effective. In contrast, 32.4% believed that such learning processes would be ineffective, whilst the remainder (37.5%) were uncommitted either way. ANOVA analysis of the relationship between programme undertaking and expectation of learning continuously online revealed a statistically significant result ($F = 3.592$, $P = 0.030$). Crosstabular analysis revealed that students in their lower level studies (Associate Degree and Higher Diploma Degree) would be more open to online study than those in a Bachelor's or Master's Degree course.

4.4 Discussion and Analysis

Despite the digitalisation of higher education solutions following the Covid-19 outbreak, the transition away from classroom experiences has not wholly distanced students from their instructors, educators, and peers. Instead, new strategies for engaging students in online learning including breakout rooms, class discussions, Zoom meetings, and message boards have been developed to support student participation (Oraif & Elyas, 2021). Such communities of practice (CoPs) integrate teacher moderators and student leaders in the negotiation of the learning process, requiring both productive collaboration and active engagement to improve the nature of these exchanges (Halim, 2021). The CoP insights drawn from Anderson et al. (2020) reveal the social advantages of collaborative learning in MOOC courses and large-scale educational environments where individual consideration is marginalised by the scope and integration of the classroom itself. The feedback from the students in this survey confirms that due to the accelerated nature of this transition, many students did not receive the training and support they needed to thrive online. Moving forward, it is imperative that educational institutions consider such needs and develop additional support tools to improve the seamlessness and effectiveness of the digital instruction.

For educators confronted with the sudden and structurally radical shift from traditional to digital learning, MacIntyre et al. (2020) acknowledges an adaptation period which involves coping strategies that are determined by various forces including teacher experience, motivation, agenda-setting, and technical skillsets. Where educators do not feel sufficiently competent to engage in digital learning, experience gaps can lead to higher stress levels and less effective teaching practices, potentially threatening the learning effectiveness of the online education process (Gao & Zhang, 2020). It was evident from the feedback from these students that this transition has resulted in a somewhat effective and somewhat supportive online education environment that is likely associated with two overlapping variables: the lack of preparedness for digital learning and the lack of teacher preparedness for digital pedagogy and technological

support. As multi-role adopters in this process, University educators in Hong Kong have been challenged not only to support their classes in terms of curricular dissemination, but also in terms of technological support and accommodation, expectations that can be mitigated in the future through improved system, student, and teacher preparedness.

There are several considerations that were extracted from the student feedback that can be weighed in relation to teacher strategies and online learning support. Firstly, students are interested in high-engagement content that mirrors their expected learning cycle. This means that if educators communicate expectations up front, create opportunities for self-paced learning, and outline attainable targets or goals, students will have greater opportunities to improve their time management, school-life balance, and self-motivated learning outcomes. Further, there is a distinction in digital learning, whereby Rahman (2020) observes a difference in accountability expectations as students take control over their learning outcomes. In this way, educators become allies and students participate in an educational process that, although moderated and supported by the instructor, is not dependent upon the same daily lectures and downstream trickle of knowledge. Instead, self-regulatory behaviour based upon developing learning capabilities is viewed by Oraif and Elyas (2021) as a core antecedent to high-functioning digital learner status.

Despite the flexibility of digital learning and the critical role played by virtual learning during the global pandemic, Marshall and Wolanskyj-Spinner (2020) acknowledge that many students lack self-regulation and motivation to participate effectively in such solutions over the long term. As a result of these skill deficiencies and behavioural limitations, Daumiller et al. (2021) observe attitudinal barriers that have created conflicts between the idealised educational scenario and student experiences. Such findings are confirmed in the current study that has revealed a perceptual division amongst English students wherein some have found English learning to be effective, whilst others have failed to achieve similar outcomes and felt under-supported in their learning. Daumiller et al. (2021) conform to a similar phenomenon in relation to student burnout, whereby some students viewed digital learning as a positive challenge, whilst others adopted a negative attitude which shaped their course perceptions and their perceptions of their instructors as well. In reviewing the open-ended findings from the participants in the current study, the evidence suggests that students who thrive in digital learning will develop productive coping strategies such as modifying their learning environment, engaging in recorded materials, and communicating with educators directly. Other students who exhibited frustrations cited a lack of social experiences and motivation, as well as poor performance as their core frustrations and sources of burnout. These findings offer a baseline for support students in the future through study habits and coping strategies that target student-centred needs.

4.5 Summary

This chapter has presented the results of the empirical findings and revealed a generally positive sentiment towards digital learning amongst learners in English Language acquisition in Hong Kong. However, the evidence also indicates that without additional support and programme development, students in tertiary education will continue to experience pressures of performativity and isolation. The following chapter will conclude these findings and offer some recommendations for further research in this field.

5 Conclusion and Recommendations

5.1 Conclusion

First and foremost, the authors would like to thank their academic fellows who kindly disseminated and encouraged their students to join this research project. Since 2018, Hong Kong has established its position as a digital leader by introducing online and hybrid courses designed to meet the changing needs of students and educators in higher education in Hong Kong. As a result of the 2020 pandemic, the unprecedented shift towards virtualisation of most university courses has resulted in positive and negative experiences amongst students and educators. Accordingly, the primary aim of this study is to critically assess the effects of Covid-19 on a paradigmatic shift towards online learning and the influences on tertiary education and its teaching culture in Hong Kong. By initially reviewing the core concepts and theories in the field of study, insights regarding the transformative effects of digital learning experiences are introduced, whilst intra-pandemic findings from prior research are illuminated. Subsequently, this research captures empirical feedback from university students in Hong Kong and applies a positive psychological analysis to the consideration of future teaching strategies and educational opportunities.

This study has determined that students must develop coping mechanisms and stress-reduction strategies in order to thrive and engage in digital classroom activities. Educators can help achieve such outcomes by integrating multiple layers of pedagogy into the educational process including group work, direct discussions, video lectures, and summary insights. For learners in English Language, practice and participation are always needed. Utilising various technological resources and tools should be considered before designing future curriculum. Ultimately, the significance of this unplanned Covid-19 experiment in Hong Kong has manifested a growing range of online courses that will be supported by a teaching population that is increasingly aware of student needs, capable of self-regulation and stress management, and are flexible in the delivery of effective, integrated classroom experiences.

5.2 *Limitations*

The empirical findings presented over the course of this study were extrapolated from a structured questionnaire that was administered to students across major universities in Hong Kong. The regionalisation of this study is limited and purposeful to allow direct comparability of the results. By focusing on student experiences and perceptions, these insights have highlighted opportunities for educators to support future learning outcomes and address some of the hurdles and challenges that were identified during the pandemic. This limitation has restricted perspectives from educators and universities; however, secondary evidence from industry reports and university feedback has been used to supplement these findings.

5.3 *Recommendations*

The current study has extrapolated insights from student perceptions regarding the effects of digitalisation on intra-pandemic learning experiences. Additional research is needed to explore the effectiveness of learning strategies and habits, whilst further feedback from inside stakeholders should also be considered. The following two studies are recommended for expanding the scope of research in this field:

Recommendation 1: A University-Based Case Study of Digitalisation: By capturing insider perspectives regarding the process of digitalisation and the underlying effects on pedagogy, it is predicted that strategies for improving digital learning can be introduced at the levels of educators, universities, and managerial administrators.

Recommendation 2: A Student Assessment of Digital Learning Habits: Through an experimental assessment of the effects of positive digital learning habits on student learning capabilities, it is predicted that blueprints for improving student learning in digital environment can be developed to support future student development.

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ICT Virtual Multimedia Learning Tools/Environments: Role and Impact on ESL Learners' Development of Speech Accuracy—YouTube as an Example



Azzam Alobaid

Abstract The present study proposes using YouTube as a widely used multimedia learning tool to provide and enhance a virtual multimedia learning environment for learners' L2 proficiency development. This study hypothesizes that ESL learners' high engagement with and frequent exposure to the provided and enhanced multimedia learning environments can ultimately lead to improving their L2 oral accuracy of daily language use and expression over time. This correlational study investigated the speech accuracy progress of 14 bilingual Arabic ESL learners of intermediate English level in New Delhi over five months. In this respect, a large number of metrics ($n = 12$) of both quantitative and qualitative nature was used to investigate the performance of the same group (i.e., treatment group) of learners using a One-Group Pretest–Posttest Design ($O_1 X_1 O_2$). The findings showed that ICT tools can be helpful for ESL learners of intermediate level due to their positive and enhancing multimedia learning effects.

Keywords ICT · Virtual multimedia learning tools/environments · Engagement · Exposure · Speech · Accuracy · YouTube captioned videos

1 The Role and Impact of ICT-Based Multimedia Learning Tools/Environments on ESL/EFL Learning: Overview

Evidence shows that the use and exposure to Information and Communications Technology (ICT) multimedia learning tools/environments in education plays a significant role and creates a positive impact on ESL/EFL learners' performance across different stages/levels of L2 learning and development, especially for E-learners (Aoki, 2010). It is not possible in this digital era to consider multimedia learning without accounting for the use of ICT tools as a collaborative means through which it is possible to set up virtual multimedia learning environments for ESL/ EFL learners. In such virtual

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143

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environments, ICT can promote learners' all-time engagement and exposure during learning and enquiry about concerned subjects of education. Implementing ICTs into the curriculum provides instructors with an invaluable opportunity to enhance student engagement and academic success. Moreover, the benefits that ICTs bring to ESL learners are many such as motivation enhancement (Schoepp & Erogul, 2001), learner independence, and acquisition of skills (Galavis, 1998), so much so they have been adopted by a large number of educational institutions in many countries in the world (Buabeng-Andoh, 2012). More specifically, technology engages students behaviorally (i.e., more effort and time spent participating in learning activities); emotionally (i.e., positively impacting attitudes and interests towards learning); and cognitively (i.e., mental investment to comprehend content) (D' Angelo, 2018). With the development of computer-based technology, online multimedia learning environments [with their ever-increasing affordances and features] could support and help L2 learners engaging with richer interactions and having better learning experiences (Mayer & Mayer, 2005; Suthers, 2006).

Multimedia learning is a concept about displaying a combination of more than one media type such as text, image, graphic, drawing, sound, video, and animations usually with the aid of technology for the purpose of enhancing understanding or memorization (Guan et al., 2018). Abdulrahman et al. (2020) reviewed 78 articles and found that text (26.8%) is the predominant multimedia component being used in most of the educational materials, whereas other components such as videos (19.5%), audios (18.3%), images (18.3%) and animation (11.0%) are fairly used in teaching and learning multimedia materials. They added that perhaps the combination of these four major components (text, video, audio, image) provides the best outcome for the learner and points to the place of text as the most desired multimedia component. Research showed that multimedia components such as text and videos have positive multimedia learning effects and may be used for their cognitive advantages for ESL learners. Such potentially positive effects and advantages are their ability to increase the learners' attention to both L2 forms and meaning, especially to the (new) target language input and their speech errors/ gaps, process more information in the working memory, increase their comprehension of the spoken language input and ultimately recall these information whenever required from the long-term memory for later communicative tasks (Alobaid, 2021; Danan, 2016; Kovacs & Miller, 2014; Winke et al., 2010). Such a positive role can have a beneficial impact on receptive and productive language skills (Suthers, 2006).

Considering such advantages of ICT multimedia tools which can positively impact learning outcomes and learning environment, the present study proposes using YouTube as a widely used multimedia learning tool known for its ever-increasing multimedia features/affordances to provide and enhance a multimedia learning environment for learners' L2 speech proficiency development. More specifically, YouTube multimedia affordances such as the captioned videos are proposed in this work as a visual salience technique for their potentially positive multimedia effects and cognitive advantages to create and enhance a multimedia learning environment to help ESL learners focus on and engage more with the (new) target language input, be more able to notice their speech errors/ gaps and correct them by way

of conscious comparisons between their own oral output and target language input used in such multimedia learning environments (Alobaid, 2021); in effect, their L2 speech will likely become more accurate over time. Visual salience techniques or attention-enhancing techniques [in this case captioned videos] may be necessary to help learners adapt to English natives' natural interactions, speech-delivery speed, or the syntactic complexity of multimedia materials (Vanderplank, 2016).

Apparently, several previous studies demonstrated that ICT-based multimedia learning tools like YouTube can be implemented in many ways and occasions to enhance teaching and learning the ESL/EFL speaking skills. Brophy (2004) reported that the use of videos in teaching speaking presents interesting and understandable material for building up students' speaking ability. Riswandi (2016) as cited in Meinawati et al. (2020) showed that the implementation of YouTube-based videos in teaching speaking can improve the students' speaking skills and motivation. However, limited research has been found to examine the role and impact of ICTs like YouTube in terms of engagement, frequency of exposure/use, and perceptions among ESL/EFL learners with regard to their L2 speech proficiency development. This work presents a model integrating cognitive and multimedia aspects of learning with ICT multimedia learning tools that allowed us to derive questions for the present research in this area and also this could lend a fresh perspective to this field of research.

2 Motivation of the Study

This research was incentivized primarily by (and actually took a great advantage of) the young learners' passionate engagement with multimedia technology and the huge amount of time spent daily while they use online multimedia platforms such as YouTube for learning languages. Tso (2019) found that among the many media platforms used by Chinese EFL learners at the age of 10–15 for learning about the target language, the most common ones were YouTube (90%), Facebook (56.7%), WeChat (33.3%), Instagram (33.3%), and WhatsApp (30%); this is indicative of how much of their learning time is spent on ICT multimedia like YouTube. YouTube is one example of the widely known and used educational social multimedia platforms that operate to enhance the learning process, allow students to become more familiar with technology, meet learning goals, and collaborate with peers and instructors [pre and] after school hours. Whether technology is integrated during class time or after school hours, learners will be more likely given greater opportunities to interact with instructors, collaborate with peers, and engage themselves in the learning process. In this regard, it was important in this work to consider how learners receive technology when implementing it into the classroom because if they perceive that the attributes of a given technology are engaging and beneficial to their learning, they will more likely adopt that technology and use it to enhance their learning and understanding of course content. Generally, prior research demonstrated the learners' high levels of satisfaction and engagement with the use of educational technology as it allows them to interactively engage in learning (Miller et al., 2012). Numerous studies have

supported the idea that overall student motivation and engagement in learning can be enhanced by the implementation of instructional technology (Mo, 2011).

In this work, the high engagement with and frequent exposure time to ICTs as influential factors as well as the above-cited potential positive multimedia effects/cognitive advantages of ICTs in language education (i.e., YouTube captioned videos) underly the significance of implementing ICT-based multimedia learning tools/environments in ESL classes for the development of learners' speech accuracy. More specifically, YouTube multimedia affordances such as the captioned videos (i.e., multimedia of text and video) are proposed as a visual salience technique for their positive multimedia/cognitive effects to create and enhance a multimedia learning environment to help ESL learners focus on and engage more with the (new) target language input, be more able to notice their speech errors/gaps and correct them by way of conscious comparisons between their own oral output and target language input; in effect, their L2 speech can potentially become more accurate over time. Noticing a problem such as a speech error/gap can push learners to modify their own output. This may force L2 learners into a syntactic processing mode (Swain & Lapkin, 1995), which may help learners to internalize new forms (Pica et al., 1989) and ultimately improve the accuracy of their existing grammatical knowledge (Nobuyoshi & Ellis, 1993). It should be mentioned that noticing can occur through learners' conscious reflection and monitoring or through triggers (i.e., learners can be made conscious) provided by others such as the language instructor to notice their gap(s), especially in terms of gaps related to the accuracy of language use in the provided input—what becomes intake for learning as implied in the Noticing the Gap Hypothesis (Schmidt, 2001). With regard to attention, it is well documented that language learners are often faced with a string of sometimes incomprehensible input and need to focus attention on particular parts of language as aspects of the learning process. In fact, Schmidt (2001) claims that attending to particular parts of language “appears necessary for understanding nearly every aspect of second and foreign language learning”. This claim is integral to Schmidt's (1990, 2001) noticing hypothesis: awareness (through attention) is necessary for noticing, which in turn is essential for learning. Schmidt and Frota (1986) suggested that “a second language learner will begin to acquire the target-like form if and only if it is present in comprehended input and ‘noticed’ in the normal sense of the word, that is, consciously”. The idea presented here is that learning requires a learner to be actively involved or attending to L2 forms in order for learning to take place. However, at times, the language input (in this case the video) may be so complex that it is necessary for learners to have some sort of aid (in this case captioning) (Markham, 1993, as cited in Winke et al., 2010).

3 Purpose of the Study

This work is a quantitative and qualitative longitudinal investigation of the speech accuracy progress of 14 bilingual Arabic ESL learners of intermediate English level

at the Iraqi school in New Delhi over a period of five months. This study had four purposes: (a) to determine if the speech accuracy of ESL learners improves after the implementation of the proposed ICT-based multimedia learning tool for the improvement of ESL speech accuracy, given that they are engaging with and exposed to ICT multimedia during their L2 learning process (b) to determine the correlation between ESL learners' engagement with and frequent exposure to the proposed ICT-based multimedia learning tool and their speech accuracy improvement, if any (c) to compare between ICT-based learning tools with non-ICT-based learning tools (available in the learning environment of this group of learners and used by them for speech proficiency improvement) with reference to these learners' engagement rate and frequent exposure to each of these language learning tools/environments (d) to determine the ESL learners' personal perspectives on the use of affordances of ICT virtual multimedia learning tools/environments (i.e., YouTube captioned videos) for the development of their L2 speech accuracy.

This research highlights and takes advantage of the potential role and cognitive advantages of multimedia learning for ESL learners through exposure to ICT multimedia learning tools, taking YouTube as an example of such ICT multimedia learning tools. The main aim centered around understanding *whether ESL learners' English literacy, especially English speech accuracy, would be affected by ICT multimedia learning tools (due to their multimedia learning effects and cognitive advantages) such as YouTube over time?* The answer to such significant research question, which is about an important language sub-skill (i.e., speech accuracy), would provide practical guidelines and implications for ESL teachers/learners and researchers in the field about the virtual multimedia language learning tools/environments with a special focus on L2 speech proficiency development. This study set and addressed the following research questions.

4 Research Questions

1. Does the speech accuracy of ESL learners improve after the implementation of the proposed ICT-based multimedia learning tool (i.e., YouTube captioned videos) for the improvement of ESL speech accuracy, given that these learners are engaging with and frequently exposed to ICT multimedia during their L2 learning process?
2. What is the correlation between ESL learners' speech accuracy improvement, if any, and their engagement with and frequent exposure to the proposed ICT-based multimedia learning tool (i.e., YouTube captioned videos) during their L2 learning process?
3. What are the ESL learners' personal perspectives on the use of affordances of ICT virtual multimedia learning tools/environments (i.e., YouTube captioned videos) for the development of their L2 speech accuracy?

5 Materials and Methods

To examine the role and impact of ICT multimedia learning tools/environments on ESL learners' development of speech accuracy over time, 5 male and 9 female bilingual Arabic ESL learners aged 15 were invited to take part in this project. In this respect, this correlational study employed a large number of metrics ($n = 12$) of both quantitative and qualitative nature to investigate the performance of the same group (i.e., treatment group) of learners using a One-Group Pretest–Posttest Design ($O_1 X_1 O_2$) (Zmyslinski-Seelig, 2017). This small-scale study took place at the Iraqi school, New Delhi, India. These participants were excited and keen to improve their English speech proficiency. Before the study began, the researcher clearly explained the objectives and rationale of the research to these participants. The fully informed participants agreed to take part in this study.

The first objective of this study was to determine if the speech accuracy of ESL learners improves over time due to the implementation of the proposed ICT-based multimedia learning tool (i.e., YouTube captioned videos) for the improvement of ESL speech accuracy, given that they are engaging with and frequently exposed to ICT multimedia learning tools during their L2 learning process. In this regard, different outcomes were measured by the repeated measures test ($O_1 X_1 O_2$), which was conducted before and after the implementation of the YouTube as an ICT multimedia learning tool for the improvement of ESL learners' speech accuracy (Table 1). In this design, the potential effect of a treatment ($X_1 =$ the implementation of YouTube) could be determined by calculating the difference/variation between the first assessment of the dependent variables (i.e., the pretest or $O_1 =$ learners' speech accuracy before the treatment) and the second assessment of the dependent variables (i.e., the posttest or $O_2 =$ learners' speech accuracy after the treatment). The dependent variables in this study were the metrics ($n = 12$) used to gauge the likely learners' speech accuracy progress (see below in this section for information about these metrics), if any, over time. In this regard, the learners' responses ($n = 84$ in total) to the given oral test samples¹ ($n = 6$ in total) were scored to provide a measure of the participants' performance on the speaking practice tasks, which helped to answer the first research question. This test involved using IELTS²-based speaking tasks, taking into consideration all the criteria and standards of IELTS while administering this test in class and analyzing its outcomes (i.e., participants' scores of this test) by three linguists. The second objective was to determine the correlation between ESL learners' engagement with and frequent exposure to the proposed ICT-based multimedia learning tool and their speech accuracy improvement, if any, after adopting this tool for the improvement of ESL speech accuracy. In this respect, different outcomes

¹ Participants were given three oral test samples before and three after the experiment to set the baseline and end line in this study. The test speaking tasks included 1. introduction and interview (4–5 mins) 2. individual long turn (3–4 mins) 3. two-way discussion (4–5 mins).

² IELTS stands for International English Language Testing System.

were set by the questionnaire questions (Qs. 4 & 29, Appendix). The third objective of this study was to compare³ ICT multimedia learning tools with the non-ICT multimedia learning tools/environments for each of the aforementioned variables (i.e., engagement rate, frequent exposure to language learning tools/environments, i.e., these were the two independent variables employed in this study, see below in this section for more information). In this respect, different outcomes were set by the questionnaire questions (Appendix). The fourth objective was to determine the ESL learners' personal perspectives on the use of affordances of ICT virtual multimedia learning tools/environments (i.e., YouTube captioned videos) for the development of their L2 speech accuracy. In this respect, different outcomes were set by the questionnaire question (Q30, Table 6). The questionnaire⁴ (*n.* 30 in total) was conducted online at the end of this study (Appendix). Participants were to fill out this questionnaire which collected information about their daily digital and non-digital literacy practices with regard to engagement rate, frequent exposure to language learning tools/environments and their personal perspectives toward ICT multimedia learning tools such as YouTube and its impact on their English speech accuracy development. Basically, this questionnaire focused on learners' personal experience and potential benefits of YouTube captioned videos used for ESL oral accuracy development to identify and record the role and impact of YouTube on ESL oral accuracy progress. The survey (30 questions) was comprised of Likert and closed-ended items. The questionnaire items (Qs. 4–29, Appendix) provided data for the quantitative analysis part of this study (i.e., correlation analysis). The questionnaire item (Q.30, Table 6) provided data for the qualitative analysis part.

The analysis part of this work involved a large number of metrics (*n.* 12) of both quantitative and qualitative nature which was employed to observe, measure, and quantify the potential progress of 14 bilingual Arabic ESL learners' speech accuracy. These metrics, which are widely cited in SLA literature of L2 speech accuracy, were employed as the dependent variables in the analysis of the participants' L2 progress in terms of speech accuracy over five months and the correlational analysis part in this study. These metrics were (1) *Self-corrections rate* described as perceived deficiencies in one's own language and measured by identifying the four major types of self-corrections, namely, *error repair* (i.e., an accidental lapse in speech processing is corrected. Such lapses can occur at any phase of the production process—that is, during lemma retrieval, grammatical and phonological encoding, and articulation.), *appropriacy repair* (i.e., occurs when the speaker realizes that he or she has provided inadequate or inappropriate information in the utterance and repairs it), *different-repair* (when applying different-repair, the speaker decides to encode information that is different from what he or she is currently formulating, i.e., changes the original speech plan) and *rephrasing repair* (involves a revision of the preverbal plan but

³ This comparison was basically done to control for other variables (AKA confounding factors) which might be playing a role along with the potential YouTube role in the likely development of learners' speech accuracy for this sample group and thus make a valid judgment.

⁴ This questionnaire was adapted from Alobaid (2020) and partially modified by the author to fit with the objectives and context of this work, following Dörnyei and Csizér (2012) for designing and analyzing surveys in second language acquisition research.

differs from appropriacy and different-repairs in that it does not affect the macro-plan) (Dörnyei & Kormos, 1998); (2) **Percentage of error-free clauses** expressed as the percentage of clauses which do not contain any error to the total number of clauses (Yuan & Ellis, 2003); (3) **Errors per 100 words** measured by number of errors divided by the total number of words produced divided by 100 (Bygate, 2013); (4) **Incidence of errors per AS-unit**⁵ measured by dividing the number of errors by the number of AS-units (Bygate, 2013); (5) **Number of error-free units per unit** measured by dividing the number of error-free AS-units by the total number of AS-units in a speech sample (Takiguchi, 2003); (6) **Number of errors per word** measured by dividing the number of errors by the total number of words in a speech sample excluding dysfluencies (Wang et al., 2003); (7) **Lexical range & accuracy** measured manually by the author and cross-checked by three linguists as prescribed by the IELTS speaking band descriptors available online; (8) **Target-like use of vocabulary** measured by the number of lexical errors divided by the total number of words in a speech sample, excluding dysfluencies (Skehan & Foster, 1997); (9) **Grammatical range & accuracy** measured manually by the author and cross-checked by three linguists as prescribed by the IELTS speaking band descriptors available online; (10) **Target-like use of grammar (articles)** measured by the number of correctly used articles divided by the obligatory occasions for articles multiplied by 100; the author measured this metric in the same manner Crookes (1989) measured *the target-like use of grammar (plurals)* speech accuracy metric; (11) **Target-like use of grammar (plurals)** measured by the number of correctly used plurals divided by the obligatory occasions for plurals multiplied by 100 (Crookes, 1989); (12) **Target-like use of grammar (verbal morphology)** measured by the number of correct finite verb phrases divided by the total number of verb phrases multiplied by 100 (Wigglesworth, 1997).

In line with the hypothesis of this work, the author employed the learners' exposure time and engagement rate and factored them into the correlation analysis (as the independent variables) and interpretation of the results in this work due to their huge popularity in literature as significantly influential drivers and necessary prerequisites for learning foreign/ second languages (see Benson, 2013; Ellis, 2002; Peregoy & Boyle, 2001; Sarason & Banbury, 2004; Bertin et al., 2010). Early studies defined student engagement primarily by observable behaviors such as participation and time on task (Brophy, 1983). Researchers also incorporated emotional or affective aspects into their conceptualization of engagement (Connell, 1990). It can be understood from these definitions that engagement includes feelings of belonging, enjoyment, and attachment, which is how this study defined the learners' engagement factor for its analysis. Time range of exposure factor was defined for this study as "the contact that the learner has with the target language that they are trying to learn, either generally or with specific language points" (British Council, 2020). With respect to the engagement rate, it was measured on a five-point Likert scale where 1-point was defined as very low engagement and 5-points as very high engagement. As for the

⁵ An AS-unit (Analysis of Speech unit) is "a single speaker's utterance consisting of an independent clause or subclausal unit, together with any subordinate clause(s) associated with it" (Foster et al., 2000).

range of daily active exposure time, it was defined by the number of hours spent in a day using each of these tools for learning English and measured on a five-point Likert scale. Time range of exposure was coded as the following: 0 h = null exposure, 1 h = one hour, 2 h = two hours, 3 h = three hours, 4 h + = four hours and above.

Also, the author ran three statistical tests to analyze the data collected in this study. First, Wilcoxon test was used to process the data elicited from the learners' test scores before and after the experiment and thus to be able to account for any potential variation in this regard (see Table 1 for Wilcoxon test results). This test was suitable as the same group of participants were to be examined at two different points of time, which was the case in this work (Scheff, 2016). In this study, the critical P value for a 95% confidence interval was used for testing our hypothesis. Second, Spearman correlation test was used to explore the strength and direction of the relationship between the learners' L2 speech accuracy progress after the experiment, if any, (i.e., this represents the dependent variables for this correlational analysis whose data were the participants' scores of the post-test speaking tasks provided in Table 1) and the language learning tools available to this group of learners with respect to the learners' engagement rate with and daily active exposure time to each of these language learning tools, including ICT multimedia learning tools like YouTube (i.e., this represents the independent variables for this correlational analysis whose data were elicited from participants' responses to questionnaire items (Qs 4–29, Appendix). As for the strength of the relationship between these variables, the critical value for Spearman $|r|$ was set at $0.05 = 0.464$. This was the significance level for a two-tailed test which can be found in the critical values table of the Spearman's ranked correlation coefficient (r_s) (Zar, 1999, Table B.19). The degree of freedom $df = N-2$, $df = 14-2 = 12$. Correlation coefficient values below 0.464 were considered insignificant and those above 0.464 were significant. The higher the r value or closer to $+1/-1$, the stronger the correlation is between two variables. Consequently, the better the learners' oral accuracy is. As for the direction (i.e., positive = +ve/negative = -ve) of relationship between these variables, the oral accuracy metrics (dependent variables) in the correlation Tables 2, 3, 4, 5, namely *Self-corrections rate*, *Lexical range & accuracy*, *Grammatical range & accuracy*, *Percentage of error-free clauses*, *No. of error-free units per unit*, *Target-like use of grammar (articles)*, *Target-like use of grammar (plurals)*, *Target-like use of grammar (verbal morphology)* should be positively correlated with the independent variables as these dependent variables dealt with desirable aspects of oral accuracy. However, the other oral accuracy metrics, namely *Errors per 100 words*, *Incidence of errors per AS-unit*, *No. of errors per word*, *Target-like use of vocabulary*⁶ should be negatively correlated with the independent variables since these dependent variables dealt with undesirable aspects of oral accuracy, i.e., errors which can be found in learners' oral speech; the lower the number of errors mean the higher oral accuracy is. The results yielded from this correlational analysis were employed to answer the second research question in this study (see test results in Tables 2, 3, 4, 5). Third, the qualitative analysis part, which was based on Content analysis and Frequency Distribution, was employed to analyze the data elicited from the participants' responses to the questionnaire item (Q30, see test results in Table 6). This test was run using one closed-ended question (Q30, Table 6).

This question concerns these ESL learners' personal perspectives about affordances of ICT virtual multimedia learning tools/environments for the development of their L2 speech accuracy. Participants' actual responses signified the potential role and impact of the frequent use of YouTube-based multimedia videos on the learners' ESL oral accuracy development through indirectly exploring their personal experience in terms of the benefits gained from the actual use and potential advantages of the YouTube-based multimedia videos, especially when used for ESL oral accuracy development. Participants were required to tick (if they agreed or not with) the given statements according to their actual experience. These statements were structured around the main research questions in this study and are widely discussed in recent SLA literature which relate to the adopted theories in this study for the development of ESL learners' speaking proficiency. As for the questionnaire findings, all participants' responses ($n = 14$) were downloaded to Microsoft Excel sheets and subsequently exported to SPSS version 21.0 for statistical analysis purposes.

In this study, speech accuracy is defined and interpreted as the ability to produce error-free speech (Lennon, 1990), i.e., the extent to which the language produced conforms to target language norms (Yuan & Ellis, 2003), which involves the correct use of pronunciation, vocabulary, and grammar. These working definitions share the same notion about the correctness of learners' output as opposed to deviations from the norm which are usually characterized as errors. In this work, speech accuracy was determined with respect to learners' errors in grammar, morphology, vocabulary (pronunciation was out of the scope of this study). For evaluating learners' speech accuracy tasks and identifying their speech errors, the author used a number of metrics ($n = 12$) as mentioned above and used the taxonomy of errors suggested by James (2013). This taxonomy involved grammatical and morphological aspects (i.e., omission, addition, misinformation, mis-ordering and blends). In this respect, learners' speaking tasks were rated by three specialists in the field and the inter-rater reliability analysis for the total speaking tasks ($n = 84$) showed Cronbach's alpha $\alpha = 0.83$.

6 Procedures

YouTube was at the core of every English-speaking class to learn from its videos content in "a watch-take notes-discuss" learning modality. The *BBC Six-Minute English* YouTube channel was proposed by the author as it was only a six-minute show designed for intermediate learners of English, and it matched the learners' language proficiency level. Basically, the speaking tasks and activities given to participants were structured around the language content and topics of these YouTube videos i.e., task-based learning. The English used in these videos was General English presented in an informal and conversational style to help learners practice authentic English in their daily lives, i.e., using English to speak about something. The presenters in this YouTube channel teach the target language (i.e., in this case English) that learners can use to discuss and talk about a given topic. In this study, YouTube captioned

videos were essentially proposed for their positive multimedia/cognitive effects to create and enhance a multimedia learning environment to help ESL learners focus on and engage more with the (new) target language input, be more able to notice their speech errors/gaps and correct them by way of conscious comparisons between their own oral output and the target language input introduced through these videos. Schmidt (1990, 2001) stated that target language input does not become intake for language learning unless it is noticed (i.e., consciously registered), and that in order to overcome errors, learners must make conscious comparisons between their own output and target language input. In this regard, the proposed affordances of YouTube video captions can be helpful if utilized for their multimedia effects, i.e., to draw the learners' attention to the target language input (i.e., for conscious comparisons) and to help them clearly notice their speech errors/gaps and make conscious comparisons between their own output and target language input. As implied by Thornbury and Slade (2006), when teaching/learning of conversation, current thinking tends to support a view of learning which combines features of indirect and direct learning in alternating cycles of performance and instruction. Since this work adopts a task-based learning approach, there was a need for a periodic focus on form (where YouTube-captioned videos as a visual salience technique comes into play) either pre, during, or post-task (Doughty & Williams, 1998). In this study, the focus on form(s) was mainly done post-task in these speaking classes.

Given the positive multimedia effects and cognitive advantages of video captions, this group of ESL learners was encouraged by the researcher to use YouTube captioned videos as a visual salience technique in many ways and for different purposes both at home on their own and at school while they were learning about English speaking using some YouTube video. The following were the actual practical steps taken for the operationalization of captioned videos multimedia effects with the aim of promoting L2 speech accuracy in ESL speaking classes. For example, these learners and the researcher would use the proposed technique wherever there was a need for:

- **increasing learners' comprehension** of the topic and the spoken language input of a given YouTube video;
- **increasing learners' attention**, especially to the (new) target language input and their speaking errors/gaps;
- **processing** more information in the working memory;
- **analyzing** and practicing (processing) of what is taken in through the captions (i.e., the new target language input used by the presenters in a given video to introduce a new topic) in terms of both content (i.e., lexical items) and forms (i.e., grammatical/morphological structures);
- **checking on** (i.e., by way of conscious comparisons between their own (i.e., learners') output and target language input) the right meaning of some sentence in a given context or to check problematic/unfamiliar grammatical forms/vocabulary; the accuracy of word choice, morphological/grammatical structures they came across in a given video;
- **retaining** information whenever required from the long-term memory;

- **taking notes** of specific language points used in the videos to help analyze the target language;
- **referring to and highlighting** interesting and significant language points/inquiries such as those directly raised by the learners themselves, or related to learners' errors in their English speech and noticed by the learners and/or the instructor;
- **pointing out** some language points (i.e., using the video captions for that matter) whenever found noteworthy, relevant, and enriching for the learners' speaking experience.

7 Research Findings and Discussion

The lack of research about the role and impact of using ICT virtual multimedia learning tools/environments on ESL learners' development of speech accuracy was found in the literature. This incentivized carrying out the present study. What can be construed from our study findings is that using YouTube as an ICT multimedia learning tool to provide and enhance a virtual multimedia learning environment (by way of YouTube captioned videos) seemed to play a relatively significant role which positively impacted the development of ESL learners' oral accuracy of daily language use and expression over time. This study yielded a number of observations and findings which supported the concept of the effectiveness of using YouTube captioned videos. The obtained results are further discussed and interpreted in light of relevant previous research below.

With regard to the first research question, the findings of this study (Table 1) demonstrated statistically significant differences in some ($n = 3$) but not all of the quantitative and qualitative aspects of the learners' L2 speech accuracy (as indicated by the metrics used in this study for measuring the learners' speech accuracy progress, see the Materials and Methods, Sect. 5) after five months of the actual use of the provided and enhanced multimedia learning environment (by way of YouTube captioned videos) which was proposed for the development of learners' L2 speech proficiency. As shown by Wilcoxon Matched-Pairs Ranked Test results (Table 1), the post-test scores were statistically significantly higher than pre-test scores in terms of Self-corrections rate $Z = -3.17, p = .002, d = -0.60$; Lexical range & accuracy $Z = -3.4, p < .001, d = -0.64$; Grammatical range & accuracy $Z = -3.28, p < .001, d = -0.62$.

However, other aspects of learners' speech accuracy developed slightly but with no statistically significant difference as indicated by the metrics used in this study, namely *Percentage of error-free clauses*, *Errors per 100 words*, *Incidence of errors per AS-unit*, *No. of error-free units per unit*, *No. of errors per word*, *Target-like use of vocabulary*, *Target-like use of grammar (articles)*, *Target-like use of grammar (plurals)*, *Target-like use of grammar (verbal morphology)*. The significant results of this test (Table 1) suggested that, by and large, some improvement in the accuracy of English speech was made by this group of learners after five months of the

Table 1 Summary table of Wilcoxon matched-pairs ranked test results: Baseline and End line of learners' speech performance after five months of exposure to YouTube: statistically significant differences based on p value < 0.5

Speech accuracy metrics	Baseline test scores: mean (SD)	End line test scores: mean (SD)	(End line-score) - (Baseline-score)				Wilcoxon signed rank		Effect size (Cohen's d value)
			Neg. rank	Posit. rank	Ties	Total	Z	P -value	
Self-corrections rate	16.8 (9.41)	39.61 (24.08)	1	13	0	14	-3.17	0.002	-0.599262672
Percentage of error-free clauses	55.27 (20.86)	55.20 (20.38)	8	6	0	14	-0.53	0.59	-0.100916514
Errors per 100 words	0.0007 (0.0003)	0.0007 (0.0002)	8	4	2	14	-0.44	0.66	-0.083530149
Incidence of errors per AS-unit	0.72 (0.37)	0.62 (0.26)	10	3	1	14	-1.57	0.12	-0.296702111
Number of error-free units per unit	0.52 (0.16)	0.55 (0.15)	7	7	0	14	-0.44	0.66	-0.083152184
Number of errors per word	0.075 (0.035)	0.072 (0.029)	9	5	0	14	-0.53	0.59	-0.100160585
Lexical range & accuracy	4.21 (0.97)	5.64 (1.22)	0	14	0	14	-3.4	0.001	-0.642539604
Target-like use of vocabulary	0.04 (0.026)	0.03 (0.019)	10	3	1	14	-1.86	0.06	-0.35150696
Grammatical range & accuracy	4.07 (0.99)	5.43 (1.4)	0	13	1	14	-3.28	0.001	-0.619861736
Target-like use of grammar (articles)	74.39 (29.71)	83.31 (21.71)	4	9	1	14	-1.47	0.14	-0.277803888
Target-like use of grammar (plurals)	73.47 (16.43)	69.39 (16.90)	8	6	0	14	-0.72	0.47	-0.13606721

(continued)

Table 1 (continued)

Speech accuracy metrics	Baseline test scores: mean (SD)	End line test scores: mean (SD)	(End line-score) – (Baseline-score)			Wilcoxon signed rank		Effect size (Cohen's <i>d</i> value)	
			Neg. rank	Posit. rank	Ties	Total	Z		<i>P</i> -value
Target-like use of grammar (verbal morphology)	69.71 (10.56)	71.14 (12.54)	7	6	1	14	-0.69	0.48	-0.130397743

implementation of the proposed ICT tool, namely YouTube to provide and enhance a virtual multimedia learning environment (by way of YouTube captioned videos) for learners' L2 speech proficiency development. Over five months, learners in these English-speaking classes were encouraged to use YouTube captioned videos in the manner suggested and described above (see the Procedures Sect. 6). Thus, the resultant effect in the development of these three speech accuracy metrics by this group of learners can arguably be attributable to the positive and enhancing multimedia effects and cognitive advantages provided by such ICT multimedia learning tools as YouTube. More specifically, the use of YouTube captioned videos seemed to help (to name but a few advantages & opportunities) learners in many ways which could have ultimately resulted in a more accurate oral speech (i.e., in quantitative and qualitative terms as indicated by the three concerned developed variables in this study). Firstly, it facilitated learners' comprehension of YouTube videos content/topics. Secondly, it attracted and focused learners' attention on their speech errors or gaps; this helped them notice, correct, learn from their mistakes (especially vocabulary and grammar). This could ultimately improve the overall accuracy of language use while speaking in English, i.e., through checking (by way of conscious comparison) their speech with the language used in some video content, given that the language used in some video is taken as a model, especially the language of native speakers. This conforms with findings by Winke et al. (2010) who noted that the captions served the function of drawing learners' attention to the language in the video. The captions seemed to help isolate what the learners perceived to be important and helped them determine what to pay attention to in [the present and] subsequent viewings [of some YouTube video and possibly learn from that in the long run]. Similarly, Shofi (2020) noted that the use of classroom multimedia tools [such as YouTube captioned videos] is effective to improve the English-speaking learning process whereby combining multimedia such as video with learning speaking offers many advantages such that learners can watch and see their own or their friends' work by some repetitions so that the students can alternately correct their mistakes. Consequently, learners can be more critical of themselves because they can see the side of their own shortcomings and development. Thirdly, video captions helped learners analyze the target language, attract and focus their attention on (new) language points related to the target language use of grammar and vocabulary in context; this enabled faster retention of the newly learnt information and the overall process of learning, hence the improvement of L2 speaking skill. Fourthly, captioned videos helped reinforce previous L2 knowledge and practice speaking (processing 'both meaning & form-focused') of what is taken in through the captions. Vanderplank (1990) examined the effects of using captions on learners of English over three months. He reported that watching captioned videos induced more accurate language on subsequent comprehension exercises and helped retain specific language used in the videos. Vanderplank concluded that attention "form-focused" and processing "meaning-focused" are important for the intake and long-term retention of language forms through captions. In a similar vein, Ayand and Shafiee (2016) suggested that the development of learners' L2 oral accuracy while using English subtitles (i.e., captions) was probably due to their exposure to grammatical structures of English not only through the auditory channel but also through

the visual channel (i.e., through captions), i.e., they could both see and hear the correct grammatical structures of English. From a multimedia learning perspective, ICT-based multimedia learning [through the arguably effective use of video captions] might well have enabled and sustained cognitive activity including mechanisms that are key to L2 learning, such as attention, (short and long-term) memory, comprehension, retention, and transfer (Um et al., 2012). Consequently, ESL learners' L2 speech accuracy could be enhanced. Learners can process verbal and non-verbal clues that could scaffold their mental representations of the communicative use of the targeted language forms. Learners can work at their own pace, allocating time and attention to these L2 features as they process language for meaning. That said, multimedia features such as hotspots, typographical enhancement, and captioning can increase learners' opportunities to intake the forms (Izquierdo, 2014).

Regarding the second research question, the correlation findings (Tables 2 and 3) revealed a range of moderate and strong correlations between learners' engagement rate with and frequent exposure to the proposed ICT-based multimedia learning tool (i.e., YouTube captioned videos which were proposed for the development of ESL learners' speech) and the learners' speech accuracy improvement (seen in Table 1) after adopting this tool for the improvement of ESL learners' speech accuracy.

The following are the results of the correlation analysis given in more detail and divided into two main categories—ICT-based learning versus Non-ICT-based learning.

7.1 ICT-Based Learning

The correlation coefficients (Table 2) seen between the participants' engagement rate with ICT-based mono-medium and multimedia learning tools and their speech accuracy improvement (Table 1) demonstrated various values, the majority of which were insignificant, especially in the mono-medium learning environments. However, the significant correlation values in terms of both strength (i.e., positive/negative association) and direction (i.e., linearity) were those in the multimedia environments of YouTube, video games, films, and audio books. The significant correlations can be found below (Table 2). These findings revealed that the correlations of learners' engagement were significant on the multimedia rather than the mono-medium side. More specifically, there were more significant and stronger correlations between most of the speech accuracy metrics used in this work and the multimedia of YouTube than other multimedia such as video games, films, or audio books. This may indicate that learners were engaging with the multimedia of YouTube more and to a greater extent than the rest of other learning sources in their online learning environment and that the multimedia (i.e., text & speech) were preferred over the mono-medium (i.e., either text or speech) environments.

The correlation coefficients seen in (Table 3) between participants' time range of exposure to ICT-based mono-medium and multimedia learning tools and their speech

Table 2 Spearman correlation coefficient: rate of learners' engagement with ICT-based learning/online

Speech Accuracy Metrics		Mono-medium (text/speech)		Multimedia (text and speech)					
		Reading (books)	Listening (songs)	YouTube BBC 6-min English	Video games	Songs	Films	Audio books	
Self-corrections rate	Correlation coefficient (rs)	0.495	-0.029	-0.022	-0.569*	0.014	0.300	-0.045	
	Sig. (p)	0.072	0.922	0.940	0.034	0.963	0.297	0.879	
Percentage of error-free clauses	Correlation coefficient (rs)	-0.377	0.359	0.767**	-0.124	0.257	0.108	0.225	
	Sig. (p)	0.184	0.207	0.001	0.673	0.375	0.714	0.439	
Errors per 100 words	Correlation coefficient (rs)	0.333	-0.386	-0.747**	0.088	-0.185	-0.133	-0.188	
	Sig. (p)	0.244	0.173	0.002	0.765	0.527	0.651	0.519	
Incidence of errors per AS-unit	Correlation coefficient (rs)	0.405	-0.426	-0.686**	0.064	-0.262	-0.124	-0.167	
	Sig. (p)	0.151	0.129	0.007	0.829	0.366	0.673	0.568	
No. of error-free units per unit	Correlation coefficient (rs)	-0.354	0.498	0.654*	-0.174	0.293	0.238	0.203	
	Sig. (p)	0.214	0.070	0.011	0.552	0.310	0.413	0.486	
No. of errors per word	Correlation coefficient (rs)	0.338	-0.364	-0.718**	0.076	-0.182	-0.140	-0.227	
	Sig. (p)	0.238	0.201	0.004	0.796	0.533	0.633	0.435	
Lexical range & accuracy	Correlation coefficient (rs)	-0.454	0.035	0.813**	0.036	-0.049	0.014	0.561*	
	Sig. (p)	0.103	0.906	0.000	0.904	0.867	0.961	0.037	

(continued)

Table 2 (continued)

Spearman's correlation coefficients		Mono-medium (text/speech)		Multimedia (text and speech)						
		Reading (books)	Listening (songs)	YouTube BBC 6-min English	Video games	Songs	Films	Audio books		
Target-like use of vocabulary	Correlation coefficient (rs)	0.285	-0.216	-0.620*	0.059	-0.196	-0.205	-0.401		
	Sig. (p)	0.323	0.459	0.018	0.842	0.502	0.481	0.155		
Grammatical range & accuracy	Correlation coefficient (rs)	-0.196	0.045	0.844**	-0.068	-0.085	-0.001	0.227		
	Sig. (p)	0.501	0.879	0.000	0.819	0.773	0.996	0.434		
Target-like use of grammar (articles)	Correlation coefficient (rs)	-0.113	-0.298	0.442	0.281	-0.391	-0.676**	0.088		
	Sig. (p)	0.700	0.301	0.114	0.331	0.167	0.008	0.765		
Target-like use of grammar (plurals)	Correlation coefficient (rs)	-0.404	0.211	0.887**	-0.107	0.046	0.054	0.256		
	Sig. (p)	0.152	0.470	0.000	0.717	0.876	0.855	0.378		
Target-like use of grammar (verbal morphology)	Correlation coefficient (rs)	-0.248	0.663**	0.448	-0.391	0.393	0.545*	0.090		
	Sig. (p)	0.392	0.010	0.108	0.166	0.164	0.044	0.759		

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Table 3 Spearman's correlation: time range of learners' exposure to ICT-based learning/online

Speech accuracy metrics		Spearman's correlation coefficients		Time range of learners' exposure to ICT-based learning/online						
				Mono-medium (text/speech)		Multimedia (text and speech)				
		Reading (books)	Listening (songs)	YouTube BBC 6-min English	Video games	Songs	Films	Audio books		
Self-corrections rate	Correlation coefficient (rs)	-0.456	0.073	-0.023	-0.514	0.194	-0.367	0.499		
	Sig. (p)	0.101	0.805	0.937	0.060	0.506	0.197	0.069		
Percentage of error-free clauses	Correlation coefficient (rs)	0.203	-0.072	0.788**	-0.193	-0.108	-0.216	0.111		
	Sig. (p)	0.487	0.808	0.001	0.509	0.713	0.458	0.705		
Errors per 100 words	Correlation coefficient (rs)	-0.077	0.025	-0.762**	0.170	0.022	0.349	-0.168		
	Sig. (p)	0.795	0.933	0.002	0.562	0.941	0.222	0.566		
Incidence of errors per AS-unit	Correlation coefficient (rs)	-0.051	0.055	-0.763**	0.153	-0.065	0.259	-0.074		
	Sig. (p)	0.863	0.853	0.002	0.601	0.826	0.371	0.801		
No. of error-free units per unit	Correlation coefficient (rs)	0.203	-0.047	0.684**	-0.242	-0.108	-0.367	0.092		
	Sig. (p)	0.487	0.874	0.007	0.404	0.713	0.197	0.753		
No. of errors per word	Correlation coefficient (rs)	-0.101	0.088	-0.742**	0.148	0.022	0.367	-0.166		
	Sig. (p)	0.730	0.764	0.002	0.613	0.942	0.197	0.570		
Lexical range & accuracy	Correlation coefficient (rs)	-0.211	0.087	0.748**	-0.008	0.270	-0.292	0.096		
	Sig. (p)	0.101	0.808	0.001	0.999	0.001	0.001	0.001		

(continued)

Table 3 (continued)
Time range of learners' exposure to ICT-based learning/online

		Spearman's correlation coefficients																	
		Mono-medium (text/speech)		Multimedia (text and speech)		Reading (books)		Listening (songs)		YouTube BBC 6-min English		Video games		Songs		Films		Audio books	
Target-like use of vocabulary	Sig. (p)	0.469	0.768	0.002	0.979	0.351	0.311	0.743											
	Correlation coefficient (rs)	-0.203	0.007	-0.668**	0.124	0.065	0.303	-0.167											
Grammatical range & accuracy	Sig. (p)	0.487	0.982	0.009	0.674	0.826	0.293	0.569											
	Correlation coefficient (rs)	-0.395	-0.001	0.856**	-0.139	0.382	-0.359	0.231											
Target-like use of grammar (articles)	Sig. (p)	0.162	0.996	0.000	0.636	0.178	0.207	0.428											
	Correlation coefficient (rs)	-0.254	-0.107	0.390	0.248	0.412	0.108	-0.390											
Target-like use of grammar (plurals)	Sig. (p)	0.380	0.716	0.168	0.392	0.143	0.712	0.168											
	Correlation coefficient (rs)	-0.152	-0.112	0.856**	-0.156	0.389	-0.281	-0.111											
Target-like use of grammar (verbal morphology)	Sig. (p)	0.604	0.703	0.000	0.595	0.169	0.330	0.705											
	Correlation coefficient (rs)	0.305	-0.027	0.509	-0.434	-0.347	-0.325	0.019											
	Sig. (p)	0.289	0.926	0.063	0.121	0.224	0.256	0.950											

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

accuracy improvement (Table 1) were insignificant except for *YouTube*. These findings (Table 3) seem to be in line with the above findings about the learners' engagement rate (Table 2) that while learners were giving far greater amounts of their learning time and attention in the multimedia learning environments, they gave little or no time and attention in the mono-medium learning environment. This may suggest that learners were more inclined toward the multimedia learning environments than the mono-medium environments for learning and improving their L2 speaking proficiency online. More importantly, when compared to other ICT-based multimedia learning tools, YouTube as an ICT multimedia learning tool was preferred over other multimedia learning tools as far as learning about and improving their L2 speech proficiency was concerned.

7.2 *Non-ICT-Based Learning*

The correlation coefficients seen in (Table 4) between the participants' engagement rate with the Non-ICT-based mono-medium and multimedia learning tools and their speech accuracy improvement (Table 1) demonstrated insignificant correlations across almost all the tools except for two moderate correlation values for *video games* and *audio books*. These insignificant findings may suggest that learners were not engaging their learning in the Non-ICT-based mono-medium and multimedia learning environments at all.

The correlation coefficient findings seen in (Table 5) between the participants' time range of exposure with the Non-ICT-based mono-medium and multimedia learning tools and their speech accuracy improvement (Table 1) were insignificant for most of the tools except for *reading books*. While this may suggest that learners gave a good deal of their learning time to *reading books* in the Non-ICT-based mono-medium learning environment, these correlation findings (Table 5) demonstrated that learners were not enjoying their learning time as much as they did in the ICT-based multimedia learning environment (see Table 2).

Taken together, the correlational findings about the ICT and Non-ICT-based mono-medium/multimedia learning tools with regard to the learners' high engagement rate with and frequent exposure to each of these tools indicated that a strong correlation exists between the development of speech accuracy performance of this group of ESL learners over five months and the engagement with and frequent exposure to ICT-based multimedia rather than mono-medium learning tools, namely YouTube, which was proposed as an ICT multimedia learning tool to create and enhance a multimedia learning environment (by way of captioned videos) for the development of ESL learners' speech accuracy. To put this into perspective, compared to other language learning tools in the learners' environment, ICT-based multimedia learning tools such as YouTube seem to be more engaging, and hence learners tended to spend far more of their learning time using it on daily basis for improving their speech proficiency. Consequently, this could have led to a more effective learning in their L2 speech accuracy; this may suggest the usefulness of ICTs such as YouTube which may have

Table 4 Spearman correlation coefficient: rate of learners' engagement with non-ICT-based learning/offline

Rate of learners' engagement with non-ICT-based learning/offline		Spearman's correlation coefficients									
		Mono-medium (text/speech)					Multimedia (text and speech)				
Speech Accuracy Metrics	Self-corrections rate	Correlation Coefficient (rs)	Reading (books)	Listening (songs)	Video games	Formal schooling	Films	Audio books			
			0.522	0.363	-0.569*	-0.388	0.559*	0.363			
	Percentage of error-free clauses	0.056	0.202	0.034	0.170	0.038	0.202				
	Errors per 100 words	-0.513	-0.148	-0.124	0.074	0.130	-0.148				
		0.061	0.613	0.673	0.801	0.657	0.613				
	Incidence of errors per AS-unit	0.370	0.191	0.088	-0.131	-0.302	0.191				
		0.193	0.512	0.765	0.656	0.295	0.512				
	No. of error-free units per unit	0.338	0.083	0.064	-0.111	-0.109	0.083				
		0.237	0.777	0.829	0.705	0.712	0.777				
	No. of errors per word	-0.405	-0.150	-0.174	0.055	0.149	-0.150				
		0.150	0.608	0.552	0.851	0.610	0.608				
	Lexical range & accuracy	0.403	0.183	0.076	-0.129	-0.244	0.183				
		0.153	0.532	0.796	0.659	0.401	0.532				
		0.110	-0.258	0.036	0.154	0.444	-0.258				
		0.707	0.374	0.904	0.599	0.112	0.374				

(continued)

Table 4 (continued)

Spearman's correlation coefficients		Rate of learners' engagement with non-ICT-based learning/offline											
		Mono-medium (text/speech)		Multimedia (text and speech)		Multimedia (text and speech)		Multimedia (text and speech)		Multimedia (text and speech)			
		Reading (books)	Listening (songs)	Video games	Formal schooling	Films	Audio books	Reading (books)	Listening (songs)	Video games	Formal schooling	Films	Audio books
Target-like use of vocabulary	Correlation coefficient (rs) Sig. (p)	0.297	0.123	0.059	-0.407	-0.030	0.123	0.297	0.123	0.059	-0.407	-0.030	0.123
Grammatical range & accuracy	Correlation coefficient (rs) Sig. (p)	0.302	0.676	0.842	0.148	0.918	0.676	0.302	0.676	0.842	0.148	0.918	0.676
Target-like use of grammar (articles)	Correlation coefficient (rs) Sig. (p)	0.064	0.010	-0.068	0.231	0.481	0.010	0.064	0.010	-0.068	0.231	0.481	0.010
Target-like use of grammar (plurals)	Correlation coefficient (rs) Sig. (p)	0.827	0.974	0.819	0.428	0.081	0.974	0.827	0.974	0.819	0.428	0.081	0.974
Target-like use of grammar (morphology)	Correlation coefficient (rs) Sig. (p)	-0.087	0.007	0.281	0.501	0.179	0.007	-0.087	0.007	0.281	0.501	0.179	0.007
Target-like use of grammar (morphology)	Correlation coefficient (rs) Sig. (p)	0.769	0.981	0.331	0.068	0.540	0.981	0.769	0.981	0.331	0.068	0.540	0.981
Target-like use of grammar (morphology)	Correlation coefficient (rs) Sig. (p)	-0.089	0.188	-0.107	0.074	0.035	0.188	-0.089	0.188	-0.107	0.074	0.035	0.188
Target-like use of grammar (morphology)	Correlation coefficient (rs) Sig. (p)	0.763	0.521	0.717	0.801	0.905	0.521	0.763	0.521	0.717	0.801	0.905	0.521
Target-like use of grammar (morphology)	Correlation coefficient (rs) Sig. (p)	-0.250	-0.109	-0.391	-0.260	-0.008	-0.109	-0.250	-0.109	-0.391	-0.260	-0.008	-0.109
Target-like use of grammar (morphology)	Correlation coefficient (rs) Sig. (p)	0.388	0.710	0.166	0.369	0.977	0.710	0.388	0.710	0.166	0.369	0.977	0.710

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Table 5 Spearman correlation coefficient: time range of learners' exposure to non-ICT-based learning/offline

Spearman's correlation coefficients		Mono-medium (text/speech)					
		Reading (books)	Listening (songs)	Video games	Formal schooling	Films	Audio books
Speech Accuracy Metrics	Self-corrections rate	Correlation Coefficient (rs) 0.223	-0.034	-0.103	-0.310	0.447	-0.447
		Sig. (p) 0.444	0.907	0.726	0.281	0.109	0.109
	Percentage of error-free clauses	Correlation Coefficient (rs) 0.545*	0.103	-0.448	0.103	-0.172	-0.034
		Sig. (p) 0.044	0.725	0.108	0.725	0.556	0.907
	Errors per 100 words	Correlation Coefficient (rs) -0.578*	-0.069	0.347	-0.069	0.208	0.069
		Sig. (p) 0.030	0.814	0.224	0.814	0.475	0.814
	Incidence of errors per AS-unit	Correlation coefficient (rs) -0.584*	-0.103	0.379	-0.172	0.310	0.103
		Sig. (p) 0.028	0.725	0.182	0.556	0.281	0.725
	No. of error-free units per unit	Correlation coefficient (rs) 0.563*	0.103	-0.378	0.103	-0.310	0.034
		Sig. (p) 0.036	0.726	0.182	0.726	0.281	0.907
	No. of errors per word	Correlation coefficient (rs) -0.540*	-0.103	0.378	-0.103	0.241	0.034
		Sig. (p) 0.046	0.726	0.182	0.726	0.407	0.907
	Lexical range & accuracy	Correlation coefficient (rs) 0.579*	-0.143	-0.394	0.143	0.322	-0.143
		Sig. (p) 0.030	0.625	0.163	0.625	0.261	0.625

(continued)

Table 5 (continued)

Spearman's correlation coefficients		Time range of learners' exposure to non-ICT-based learning/Offline											
		Mono-medium (text/speech)		Multimedia (text AND speech)		Multimedia (text AND speech)		Multimedia (text AND speech)		Multimedia (text AND speech)			
		Reading (books)	Listening (songs)	Video games	Formal schooling	Films	Audio books	Reading (books)	Listening (songs)	Video games	Formal schooling	Films	Audio books
Target-like use of vocabulary	Correlation coefficient (rs) Sig. (p)	-0.443	-0.103	0.241	-0.172	0.379	0.103	0.112	0.725	0.406	0.556	0.182	0.725
Grammatical range & accuracy	Correlation coefficient (rs) Sig. (p)	0.697**	-0.072	-0.322	0.072	0.107	-0.465	0.006	0.808	0.262	0.808	0.715	0.094
Target-like use of grammar (articles)	Correlation coefficient (rs) Sig. (p)	0.161	0.104	-0.035	0.311	0.380	-0.380	0.583	0.724	0.907	0.279	0.180	0.180
Target-like use of grammar (plurals)	Correlation coefficient (rs) Sig. (p)	0.688**	-0.172	-0.413	0.413	0.103	-0.241	0.007	0.556	0.142	0.142	0.725	0.406
Target-like use of grammar (verbal morphology)	Correlation coefficient (rs) Sig. (p)	0.641*	-0.104	-0.380	-0.138	-0.311	0.000	0.014	0.724	0.180	0.637	0.279	1.000

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

induced a more accurate use of oral language in some (but not all) aspects of speech accuracy over time as learners could probably, with the help of ICT-based multimedia learning (i.e., potential multimedia learning effects and cognitive advantages), handle their learning more efficiently. Similarly, Pujolá (2002) examined learners' personal experience of L2 learning vis-à-vis the utilization of video captions as opposed to transcripts. He found that L2 learners generally had better experiences with video captions than with transcripts because they felt that their listening was improving along with caption use. This suggested the effectiveness of captioned video usage more than other (captioned) materials in an L2 learning context. Also, the findings of this research confirmed previous correlational studies about the relationship between the development of the learners' L2 productive skills like speaking/writing and the effectiveness of affordances of ICT multimedia learning tools like YouTube captioned videos which can be employed for their multimedia learning effects in the L2 learning environments. Alobaid (2021) demonstrated a strong positive correlation between the development of L2 learners' writing accuracy and the frequent use of ICT tools such as YouTube with respect to its affordances of captions and their adjustable settings like font size and color (i.e., enhanced captions of videos) for the development of ESL writing accuracy. He recommended video captioning as a technique for the development of learners' L2 writing accuracy due to their positive and enhancing multimedia learning effects, where text (i.e., captions) was optionally used along with speech. Izquierdo et al. (2015) reported that ICT makes it easier for learners to access language materials, stressing an existing correlation between second language learning and the use of multimedia materials in a computer-enhanced language learning milieu showing an impact on learning behavior with increased motivation. Talaván (2010) analyzed the need for pedagogical usage of subtitles for EFL learning with the goal of improving their oral skills. She found that the didactic application of an activity based on the use of subtitles as learning support and of subtitling as the active production of subtitles by learners in front of the computer, entails a series of benefits that are worth noting: it assists learners in the development of oral comprehension skills, provides them with different types of support (visual, textual, and technological) for language development and also helps learners observe creditable input and produce perceptible output.

All in all, the correlational findings of this study supported and added value to the conclusion about our first research question, and thus suggested that there is a positive impact and significant role of using YouTube video captions to provide and enhance multimedia learning environments in an ICT-based language learning environment (i.e., text and speech) for L2 learners, which ultimately helped these learners produce more accurate L2 speech. Statistically speaking, however, it is important to remind the reader that a bivariate correlation between two or more variables, such as the kind of linear relationships found in this study between language learners' engagement rate and time range of exposure vis-à-vis their speech accuracy improvement after five months of ICT-based multimedia learning, does not mean causation but rather that a reasonable association can be established implying a degree of strength and linearity among the concerned variables (See Figs. 1 and 2).

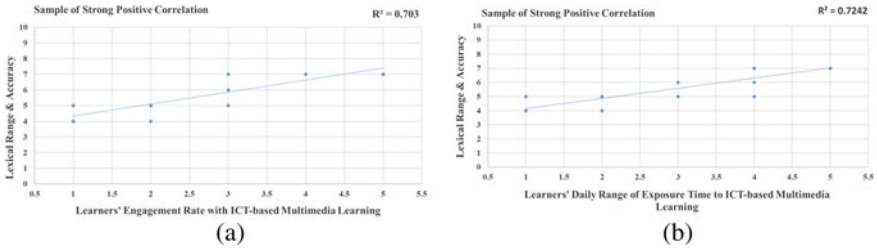


Fig. 1 Sample of positive correlations. **a** Lexical range & accuracy versus engagement. **b** Lexical range & accuracy versus time

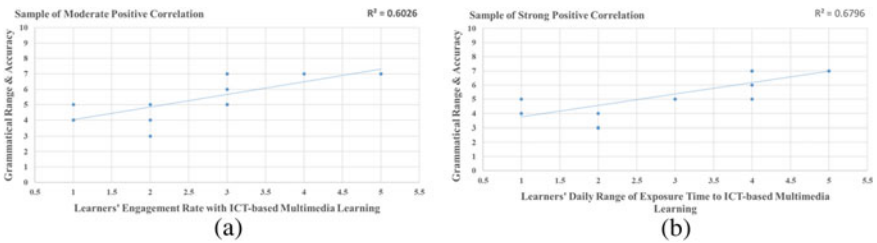


Fig. 2 Sample of positive correlations. **a** Grammatical range & accuracy versus engagement. **b** Grammatical range & accuracy versus time

With regard to the third research question, generally, learners’ personal perspectives (see Table 6) were very positive about the use of affordances of ICT virtual multimedia learning tools/environments (i.e., YouTube captioned videos), which were proposed in this study for the improvement of their L2 speech proficiency. In this work, YouTube multimedia affordances such as the captioned videos were proposed as a visual salience technique for their positive multimedia effects and cognitive advantages to create and enhance a multimedia learning environment to help ESL learners focus on and engage more with the (new) target language input, be more able to notice their speech errors/gaps and correct them by way of conscious comparisons between their own oral output and the target language input; in effect, their L2 speech may well be more accurate over time due to the positive and enhancing multimedia learning effects in such learning environments. Generally, these findings supported the quantitative results (Tables 1, 2, 3) and the hypothesis in this study—*ESL learners’ high engagement with and frequent exposure to the provided and enhanced (by way of YouTube captioned videos) multimedia learning environments can eventually lead to improving their L2 oral accuracy of daily language use and expression over time.* Learners’ responses to the questionnaire question (Q. 30. Table 6) indicated that learners substantially used YouTube videos captioning during the process of learning and improving their English speech accuracy as this could help increase their comprehension of the (new) target language input and attention to their speaking errors or gaps, analyze or decompose the (new) target

Table 6 ESL learners' personal perspectives about affordances of ICT virtual multimedia learning tools/environments (i.e., YouTube captioned videos) for the development of their L2 speech accuracy

Q30. Do you think the use of YouTube captioned videos made learning about and improving English speaking proficiency more effective for you?	(n) % responses	Implications
1-The captions can make learning English easier because they can optimize comprehension of YouTube videos content/topics. Yes No	(13) 92% (1) 8%	This demonstrates that captioning can be helpful to make videos content and language materials more comprehensible for L2 learners.
2-The captions attract and focus my attention on the speech errors or gaps; this helps me notice, correct, and learn from my mistakes (especially my vocabulary & grammar) and ultimately improve my overall language use of English speaking, i.e., through checking my speech with the language used in some video content (given that the language used in some video is taken as a model, especially the language of native speakers). Yes No	(12) 85% (2) 15%	This shows the significant role of captions for learners to notice their errors and learn from them when they speak the target language.
3-The captions help analyze the target language, attract and focus my attention on new language points related to the target language use of grammar and vocabulary; this can facilitate the retention of the newly learnt information and the overall process of learning and improvement of L2 speaking skill. Yes No	(1) 8% (13) 92%	This demonstrates that captions can be utilized to help learners analyze the target language, draw their attention and improve retention of newly learnt language and ultimately contributing to their overall L2 speaking accuracy improvement.
4-The captions create and enhance the multimedia learning environment for different learning styles; they are especially supportive for the visual and/or auditory ESL learner. Yes No	(14) 100% –	This demonstrates the assistive and positive role of captions to cater for different learning styles of ESL learners.

(continued)

Table 6 (continued)

Q30. Do you think the use of YouTube captioned videos made learning about and improving English speaking proficiency more effective for you?	(n) % responses	Implications
5-The use YouTube captioned videos helps reinforce previous L2 knowledge and practice speaking (processing) of what is taken in through the captions. Yes No	(14) 100% —	This demonstrates the ancillary role of video captions to instill previously acquired knowledge and practice (i.e., process) new incoming knowledge.

Note Adapted from *ICT multimedia learning affordances: role and impact on ESL learners' writing accuracy development*, by Azzam Alobaid. Retrieved from <https://doi.org/10.1016/j.heliyon.2021.e07517> Copyright 2021, Heliyon

language, improve processing of new linguistic input, reinforce previously acquired linguistic knowledge and practice speaking (processing) of what is taken in through the captions. Indeed, these learners seemed better able to process information through captions and that their overall caption use improved over time. These findings lend some support to previous studies such as (Winke et al., 2010) which also revealed that learners used captions as a crutch during their L2 learning. For instance, learners used video captions to increase their attention, improve processing, reinforce previous knowledge, and analyze the target language forms during their L2 learning. Also, in respect of the L2 speech accuracy development and the use of captions, Etemadi (2012) and Ayand and Shafiee (2016) reported the effective and facilitative role of using captions for acquainting L2 learners with more vocabulary and supporting their listening comprehension and language learning skills in general. They added that captions encouraged them to speak the target language more fluently and accurately.

Taken together, the findings of this research were in alignment with recent research findings by Yang (2020) and Alobaid (2020) who pointed out the cognitive advantages of YouTube captioned videos in multimedia learning environments whereby L2 learners could process language more easily using the enhanced captions, leading to the improvement of their overall language skills. Nevertheless, it should be noted that even though audio-visual materials such as video captions aid in the process of attracting the learners' attention, more specific strategies that optimize the use of captioned material like rehearsal or practice (processing) of what is taken in through the captions are also important and can make captions more beneficial (Danan, 2004). As Danan (2004) put it, "the general conclusion here is that captions can lead to significant improvement in learners' L2 proficiency development as long as they are taught to take advantage of relevant strategies". The author would recommend considering the strategies followed in this research for the operationalization of YouTube captioned videos multimedia effects for the development of learners' L2 speech accuracy (see the Procedures Sect. 6).

Nonetheless, there are some limitations and challenges of the proposed approach which should be kept in mind. First, some cognitive overload in the learners' working memories may be caused by captions. The combination of synchronized text (i.e., captions) along with speech samples may overwhelm learners' visual channels according to the dual-channel and limited-capacity assumptions of Mayer's cognitive theory of multimedia learning, i.e., "extraneous information can impede efficient processing" (Mayer, 2005). Second, captions inhibiting effects, i.e., captioning may be disturbing or turn into a crutch for L2 learners when their focus is on the onscreen text rather than listening (Danan, 2016); this can inhibit them from processing and benefiting from the input supplied by the contextual clues and aural channel (Chai & Erlam, 2008). To control for such undesirable effects, Alobaid (2021) suggests that instructors alternately use captioned and non-captioned videos according to the objectives of the lesson, learners' needs, and their L2 proficiency level. Third, the accuracy of auto-generated captions on YouTube can be a concern as far as the accuracy/acquisition of L2 language forms is concerned. These system-generated captions can be prone to errors (i.e., misrepresentation of the spoken content owing to mispronunciations, accents, dialects, background noise or when there are multi-syllable words, etc.), so the captions quality may vary. In effect, this may be confusing/disturbing to learners' overall L2 processing capacity such as comprehension, attention, analysis, and recall. Therefore, instructors are encouraged to preview captions, edit the incorrectly captioned parts for their learners and teach them not to simply focus on captions with little or no attention given to the L2 spoken language and the input supplied by the contextual clues and aural channel while watching captioned L2 videos.

8 Limitations and Recommendations for Future Studies

The one-group pre-test and post-test design ($O_1 X_1 O_2$) used in this study is relatively weak in terms of internal validity. Although this design allows researchers to examine some outcomes of interest prior to some treatment (O_1), it does not eliminate the possibility that O_2 might have occurred regardless of the treatment (X_1). For example, threats to internal validity, such as maturation and regression to the mean, could be responsible for any observed difference between the pretest and posttest. For further improvement of this study, this design can be improved upon by adding a second pretest prior to treatment administration ($O_1 O_2 X_1 O_3$) where O_1 and O_2 represent the two pretests, X_1 represents some treatment, and O_3 represents the posttest. Adding a second pretest to the traditional one-group pretest-post-test design can help reduce maturation and regression to the mean threats as plausible explanations for any observed differences (Allen, 2017). In the same vein, the author had pre-planned to apply a Time-Series Analysis (TSA) (i.e., the best measures are those that can be repeated a large number of times on a single subject at intervals of short duration) to track the possible changes over five months

(Salkind, 2010). However, due to practical reasons related to the accessibility, availability, and tight schedule of the academic year of this sample group at this school, it was only possible and feasible to do a Pretest–Posttest analysis which can be useful in such scenarios despite being relatively weak experimental design. For future studies, the author recommends primarily getting larger-scale descriptive data (i.e., involving more participants and more heterogeneous groups), using additional or more rigorous experimental designs (such as Time-Series Analysis, Multiple Regression Analysis/ANCOVA), and using parametric rather than non-parametric analytics; this will not only help validate and reinforce the findings/conclusions of this study but also bring in more robust or additional ones.

9 Conclusion and Implications

This small-scale study investigated the role and impact of using ICT virtual multimedia learning tools/environments on ESL learners' development of speech accuracy. Upon the implementation of the proposed ICT-based multimedia learning tool, i.e., YouTube, for the improvement of 14 bilingual Arabic ESL learners' speech accuracy of intermediate English level over five months, learners' high engagement with and frequent exposure to ICT-based multimedia learning environment, namely YouTube seemed to some extent conducive for the improvement of some aspects of the target language speech accuracy provided that the sources of L2 multimedia input clearly demonstrate the target language features. This study observations come to a conclusion with both quantitative and qualitative significant results on the basis of (1) the employed repeated measures test results (Table 1) after (as compared to before) the implementation of the proposed method for improving learners' speech accuracy over five months of actual exposure and engagement with the said method; (2) correlational analysis results (Tables 2 & 3) which showed statistically significant bivariate correlation coefficients between the learners' progress in terms of speech accuracy seen (Table 1) after five months of adopting the said method and the learners' actual frequent exposure to and high engagement rates with YouTube as an ICT-based multimedia learning tool; (3) the content-based and frequency analyses results which completely supported the quantitative results in this study and demonstrated the learners' actual usage and their positive attitude toward the said method in this study as seen in their affirmative responses (Table 6). Based on these findings, this paper concluded that ICT tools like YouTube captioned videos can be helpful to support the English' literacy of intermediate-level ESL learners due to their positive and enhancing multimedia learning effects and thus recommended for both language learners and teachers where optimization of speaking accuracy is the target of learning. It can be argued that YouTube captioned videos could draw learners' attention to the difference(s) between what they say (output) and what they hear and see of the same-language input (in this case the captioned videos). This helped direct learners' attention to their speech gaps/ errors and automatically correct them (by way of conscious comparison), given that learners actively engage with and are

frequently exposed to such ICT-based multimedia learning. One of the major pros of the use of captions implied in this work (with regard to learners' L2 speech accuracy improvement) is that correct and timely captioned videos can be a form of instant feedback for L2 learners; probably it can be argued here that captions can increase L2 learners' interaction with the learning materials in the new paradigm of digital communication where learning takes place online, especially in light of the global education climate in the midst of the COVID-19 pandemic. That said, instructors may encourage the use of ICTs in and out of ESL classrooms due to their multimedia effects/cognitive advantages for the development of ESL productive skills such as speaking accuracy. However, contrary to Garza's assertion (1991), given that captions may increase memorizability of the target language forms which does not warrant "the student's ability to use that language in the proper context". Therefore, learners need to be provided not only with captions but also with meaningful practice tasks supported by contextualized linguistic cues i.e., grammatical and phonological (Borrás & Lafayette, 1994) and taught to take advantage of relevant strategies for the operationalisation of YouTube captioned videos multimedia effects. Also, it should be noted that acquisition of a second/foreign language is not necessarily instantaneous; it takes time and often requires repeated input, especially when the input comes through multiple modalities [as the case in this study, i.e., captioned-videos] (Winke et al., 2010).

Appendix

Questions 4–10 related to the Rate of Learners' Engagement with ICT-based learning/online

Q.4 Rate the extent to which reading books online (Mono-medium: text/ speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.5 Rate the extent to which listening to songs online (Mono-medium: text/speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.6 Rate the extent to which watching YouTube BBC 6-min English online (multimedia: text & speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.7 Rate the extent to which video games online (multimedia: text & speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.8 Rate the extent to which watching songs online (multimedia: text & speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.9 Rate the extent to which watching films online (multimedia: text & speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.10 Rate the extent to which reading audio books online (multimedia: text & speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Questions 11–17 related to the Time Range of Learners' Exposure to ICT-based learning/online

Q.11 How much time did you spend on reading books online (mono-medium: text/speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.12 How much time did you spend on listening to songs online (mono-medium: text/speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.13 How much time did you spend on watching YouTube BBC 6-min English online (multimedia: text & speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.14 How much time did you spend on video games online (multimedia: text & speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.15 How much time did you spend on watching songs online (multimedia: text & speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.16 How much time did you spend on watching films online (multimedia: text & speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.17 How much time did you spend on reading audio books online (multimedia: text & speech) per day for learning and improving English speaking?

1. 0 h
2. 1h
3. 2 h
4. 3 h
5. 4 h +

Questions 18–23 related to the Rate of Learners' Engagement with Non-ICT-based learning/offline

Q.18 Rate the extent to which reading books offline (mono-medium: text/speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.19 Rate the extent to which listening to songs offline (mono-medium: text/speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.20 Rate the extent to which video games offline (mono-medium: text/speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.21 Rate the extent to which formal schooling offline (multimedia: text & speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.22 Rate the extent to which watching films offline (multimedia: text & speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Q.23 Rate the extent to which reading audio books offline (multimedia: text & speech) made or did not make learning and improving English speaking interesting

1. Not interesting
2. Fairly interesting
3. Interesting
4. Very interesting
5. Extremely interesting.

Questions 24–29 related to the Time Range of Learners' Exposure to Non-ICT-based learning/offline

Q.24 How much time did you spend on reading books offline (mono-medium: text/speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.25 How much time did you spend on listening to songs offline (mono-medium: text/speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.26 How much time did you spend on video games offline (mono-medium: text/speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.27 How much time did you spend on formal schooling offline (multimedia: text & speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h

3. 2 h
4. 3 h
5. 4 h +

Q.28 How much time did you spend on watching films offline (multimedia: text & speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

Q.29 How much time did you spend on reading audio books offline (multimedia: text & speech) per day for learning and improving English speaking?

1. 0 h
2. 1 h
3. 2 h
4. 3 h
5. 4 h +

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Chinese Second Language Learners' Perceptions of Gamification in an Informal Learning Environment: Duolingo as a Case Study



Liuyufeng Li and Breffni O'Rourke

Abstract In recent years, Mobile-Assisted Language Learning (MALL) and gamification have gained much attention around the world. Both learning strategies are appealing because the MALL offer learners easy and convenient access to language learning, i.e. learning resources are available anywhere and anytime via mobile devices, while gamification has been demonstrated in numerous empirical studies to be beneficial in increasing learners' motivation and engagement. However, efforts to examine gamification in Chinese as a second language (CSL) learning are still lacking, especially with regard to how CSL informal learners perceive the impact of individual game elements. The aim of this study was therefore to investigate Second Language (L2) adult learners' perceptions of a gamified MALL application and their perceptions of five typical game elements (storyline, challenge, progress bars, rewards and leaderboard) used in a typical gamified MALL application, Duolingo. The results found that storyline and rewards acted as external motivators that contributed to participants' learning motivation, while challenges, progress bars and competition acted as internal motivators that enhanced learners' persistence and developed their self-directed learning ability. In addition, for Chinese learners, the storyline facilitated their understanding and mastery of Chinese characters or words. The findings enhance our understanding of L2 Chinese learning in a gamified MALL setting. We propose several recommendations for future research.

Keywords Gamification · MALL · Chinese as a second language · Motivation · Duolingo

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1 Introduction

In recent years, the number of Chinese language learners has increased as China's economic status has grown globally. Many countries have adopted Chinese as an official foreign language subject, such as Germany and Ireland (Chinadaily, 2019). However, many adult learners are unable to attend formal Chinese language courses due to their full-time or part-time jobs, which leaves them with limited and sporadic time to learn Chinese (Glogowska et al., 2007). MALL, however, offers an informal, low-cost and portable way for adult learners to learn Chinese without the constraints of time and place (Acquah & Katz, 2020; Lam et al., 2018; Poole & Clarke-Midura, 2020).

However, a successful adult learner needs to have good self-directed learning skills and motivation in order to achieve a positive learning experience (Knowles, 1975). Yet, a majority of adult learners report that they are not interested in self-directed learning (Robinson, 1992). However, in order to have a positive learning experience, adult learners need to learn how to engage in self-directed learning. The reason for this is that they choose to use mobile devices to learn Chinese on their own without the guidance and control of an educational institution due to many unavoidable external factors, such as work (Greenhow & Lewin, 2016). At the same time, learning Chinese characters is one of the greatest obstacles for CSL learners (Gong et al., 2020; Hao, 2018), especially for Western learners, such as native English speakers, for whom Chinese is a completely foreign language, both in terms of writing and pronunciation. At the same time, due to the lack of interaction with other CSL learners, the long-term informal self-learning mode can lead to CSL learners feeling isolated and anxious (Hurd, 2005), which can lead to CSL learners gradually losing motivation and even giving up learning Chinese.

So, how can we reduce the dropout rate and increase the motivation of L2 learners who use MALL to learn their target language? Some researchers have used gamified MALL applications to explore their applicability for L2 learners. For example, Redjeki and Muhaji (2021) used Duolingo to teach English grammar in their study and found a significant positive impact on students' motivation and self-directed learning. Empirical studies on the applicability of gamified MALL to L2 learners have been numerous over the past few years, with most demonstrating that this method retains the portability features of the MALL method while using gamification settings to reduce stress and increase motivation and self-directed learning ability for language learners (García Botero et al., 2019). However, these studies have been conducted mainly in the context of Western languages, such as English, Spanish, and Dutch (García Botero et al., 2019; Loewen et al., 2019; Rachels & Rockinson-Szapkiw, 2018), and more evidence is still needed on how informal CSL learners perceive the gamified MALL and how it affects CSL learners' motivation to learn.

In this study, we examine how CSL learners perceive gamified MALL approaches and how gamification is helping to increase their motivation. We examined Duolingo,

a typical gamified MALL application, as a platform and formulated research questions based on the Goal-setting theory and social comparison and sought to analyse changes in respondents' perceptions of the gamification setting during the observation. The results showed that CSL learners found the gamified MALL to be novel and conducive to their motivation in learning.

The rest of the paper is organised as follows. First, we briefly introduce the concept of gamification and MALL. Second, we briefly describe the theoretical rationale for the design of this study. We then report and discuss the results of the quantitative and qualitative data. Finally, we discuss the limitations of the paper and make several suggestions for future research.

2 Literature Review

2.1 Gamification

Gamification refers to 'gamified experiences' (Deterding et al., 2011) designed using game elements in a non-game context, with the aim of increasing user motivation and thus boosting high engagement (Huang et al., 2019). While game elements are an essential component of the gamification process, the emphasis of gamification is on non-game contexts and non-entertainment, which helps to separate gamification from game-based and serious games. Although all three patterns are often used in instructional settings to increase learner engagement and motivation (Flores, 2015; Lam et al., 2018), game elements are only used as supporting elements in gamified settings to increase learner engagement and motivation (Huang et al., 2019) and to help learners develop their self-directed learning skills (Pacheco et al., 2020).

How does gamification affect human behaviour? In Bunchball's (2010) study, he divided the process of how gamification affects human behaviour into two terms, game mechanics and game dynamics. Game mechanics include control mechanisms such as points, challenges, levels and leaderboards, which are used to design gamification experiences to control user actions and behaviours; while the attraction and motivation that game mechanics generate for learners during the gamification experience are referred to as game dynamics, such as rewards, achievements and competition. Although we do not deliver a new model of gamification design in this study, we delineate the gamification elements in a typical gamified language learning platform based on the game mechanics and game dynamics proposed by Bunchball and select the five most commonly used gamification elements to explore informal CSL learners' perceptions towards them. The game mechanics we discuss include storyline, challenge and progress bar, while the game dynamics include reward systems and competition systems.

2.2 *MALL and Gamified MALL*

Mobile-Assisted Language Learning (MALL) is an evolution of mobile learning (m-learning), which is a language learning approach that allows language learners to learn and communicate with any type of mobile device (e.g., smartphone or pad) at any time and in any environment (Kukulska-Hulme & Shield, 2008). It emphasises the use of mobile devices to support language learning, with the advantages of providing language learners with flexibility in time and place, continuity of learning across devices, user-friendliness and cost-effectiveness (Loewen et al., 2019; Trifonova et al., 2004). Moreover, as smartphones are now increasingly common, both formal and informal language learners (Trifonova et al., 2004) have instant access to a wide range of free and up-to-date language learning materials via smartphones and the flexibility to schedule their learning according to their study habits and time. MALL also offers a virtual communicative environment that is more comfortable and relaxed for both learners and teachers than conventional face-to-face language courses, which helps to reduce learning stress (Trifonova et al., 2004). Several empirical studies have also shown that language learners are attracted to MALL, and that it has a positive effect in terms of increasing learners' motivation and knowledge of the grammar of their target language (e.g., Redjeki & Muhajir, 2021).

However, MALL also has some limitations. As MALL is a student-centred model of language learning, unlike the traditional teacher-centred approach to language education, it requires L2 learners to have self-directed learning skills (e.g., self-management and self-control) and sufficient motivation to proceed with their target language learning (Lee et al., 2017). Since most of the language resources available in MALL are web-based (Viberg & Grönlund, 2012), it means that learners will inevitably be exposed to irrelevant information for language learning. If learners lack self-management and self-control, they are likely to be distracted by irrelevant information.

For CSL learners, in particular, learning motivation is essential for them to continue learning Chinese. As empirical studies have shown, the acquisition of Chinese language (words and characters) is one of the challenges faced by CSL learners (e.g. (Hao, 2018)). For example, there are multiple meanings of one word and similar forms of Chinese characters (Gong et al., 2020). Multiple meanings of one character mean that the same character has completely different meanings or idioms in different contexts, e.g., '了'; and similar forms of Chinese characters, e.g., '王' and '玉', have completely different pronunciations and meanings despite their similar forms. These are inevitable challenges for CSL learners and they may lose learning motivation over time, especially those who are informal learners and are at higher risk of dropping out due to the lack of systematic guidance (e.g., goal setting).

Therefore, in order to help L2 learners increase their motivation to learn and thus reduce the dropout rate, Flores (Flores, 2015) suggested using gamification to help L2 learners and stated that gamification has a positive effect on learners' learning experience, which helps to increase learners' self-confidence and improve their learning performance, also enhances the sense of cooperation among learners. In addition,

several researchers have tested the effectiveness of Duolingo as a gamified MALL application in L2 classrooms, and have demonstrated that gamified MALL applications have a positive impact on L2 learners' learning attitudes (Loewen et al., 2019; Rachels & Rockinson-Szapkiw, 2018; Redjeki & Muhajir, 2021). However, more exploration is needed on the impact of gamified MALL approaches on CSL, especially for informal CSL learners. For instance, more exploration is needed on whether the use of gamification in MALL can help informal CSL learners to improve their skills in self-control and self-management, and whether it can reduce their stress in learning Chinese and increase their motivation to learn.

3 Theoretical Framework

Gamification has been widely used in second language education to stimulate learners' engagement and increase their motivation in recent years (Huang et al., 2019). The most commonly used theories in discussing how gamification motivates learners are goal-setting theory and social comparison theory. This study is a case study based on these two theories and competency-based motivation theory, and aims to investigate CSL learners' perceptions of gamification MALL and explore whether it helps to increase informal adult learners' motivation to learn Chinese. In what follows, we first briefly review the definitions of the three theories used to explain learners' motivational needs, namely goal-setting theory, social comparison theory, and competence motivation theory, and briefly analyse how these three theories support CSL learning through the five-game elements we selected in Duolingo.

3.1 *Goal-Setting Theory*

Goal-setting theory refers to the concept that learners consciously set and work towards one or multiple goals and that the goals influence the learner's motivation and academic achievement (Locke & Latham, 2002). Simply put, goal setting is the process by which learners focus their attention on activities related to a goal and then make a sustained effort. For Western learners, Chinese language learning is an easily tedious process that requires them to be able to persist over time, especially for informal learners. Therefore, setting a specific and appropriate goal for CSL learners helps them to focus on learning activities in an informal learning environment (Flores, 2015) and helps learners to assess their learning achievements and adjust their learning plans. Reward systems for game dynamics (i.e., badges) can be set as a specific performance goal (Huang et al., 2019). Badges offer learners a goal and require learners to complete a specified task in order to be awarded the corresponding badge. This facilitates learners to focus on the target learning task associated with the badge. The leaderboard is an element of the game mechanics that also helps learners to set goals and work towards them. Empirical research has demonstrated that reward

systems and competition systems can help promote learner motivation, which leads to increased task completion and engagement (Flores, 2015; Huang et al., 2019).

3.2 Social Comparison Theory

Human beings have an innate desire to compare themselves with others (Festinger, 1954). This desire to compare and compete has both pros and cons. For example, public rankings and visible badges displayed on individual pages are often used as social markers for learners to compare and compete with each other (Hamari, 2017). While this competition is beneficial to increase learner motivation, it can also lead to destructive competition (Gentzkow et al., 2014), for example, competition may negatively affect learner interactions and emotions. Hanush and Fox's (2015) study proved that inappropriate use of competitive elements can lead to negative emotions in learners. This is because learners feel restricted and forced to participate, while they also find it difficult to build interactions with other learners.

3.3 Competence Motivation Theory

The theory of competence motivation refers to the theory of achievement motivation, which is a person's perception and assessment of his or her own competence during an interaction (Harter, 1978). When learners perceive that they are capable of completing a task, their intrinsic motivation increases (Deci & Ryan, 2000) and they are thus motivated to engage in activities that demonstrate their competence. The focus of the theory is on learners' assessment of their own competence and the competencies required for the interactive activity, which influences their motivation to perform. Reward systems such as badges and points are awarded to learners for completing tasks that demonstrate learner competence. In other words, when learners are rewarded for their competence, it increases their intrinsic satisfaction, which positively influences their intrinsic motivation and continued engagement in the interaction to demonstrate their competence (Deci & Ryan, 2000; Harter, 1981).

4 Methods

4.1 Research Questions

The aim of this study was to investigate CSL informal learners' perceptions of the gamified application and the five typical game elements which have been used in Duolingo. The following research questions are thus posed.

- (1) *What are the CSL adult learners' perceptions towards using a typical gamified MALL approach to learning Chinese?*
- (2) *How the gamified MALL affects CSL informal learners' motivation in learning Chinese?*

4.2 Research Design

The purpose of this study was to examine CSL informal learners' perceptions of the gamified MALL approach and to explore which game elements might be beneficial in helping CSL informal learners to become more motivated to learn. A case study was conducted in this study using a gamified MALL platform. The research phase consisted of three stages, namely the planning stage, the action stage, and the analysis and evaluation stage. The planning phase involved identifying the research questions and establishing the theoretical basis for the study. The action phase involved the collection of quantitative and qualitative data. Quantitative data was collected in the first stage using an online questionnaire to understand the learners' perception of MALL and gamification. Six self-developed questions were included (see Fig. 1) and the internal reliability of the scale was tested by Cronbach's alpha with a reliability value of 0.891, much greater than the desirable value of 0.7 (Nunnally, 1994). We distributed the questionnaire in the L2 group on WeChat and the Duolingo learning group on Facebook. A total of 103 valid responses were obtained for the quantitative data study. The second stage was a 4-week in-depth qualitative data collection process, which was designed to gain a deeper insight into the variations of motivation and perceptions of different game elements among adult learners. A total of seven participants who completed the first stage questionnaire volunteered to participate in the second stage interviews, but only six completed the four-week Chinese learning using Duolingo and the weekly semi-structured interviews. Each interview was conducted approximately 10–15 min. The purpose of the weekly interviews was to further explore the participants' learning experiences of gamified MALL. These interviews were conducted in person ($n = 1$) and online, including via email ($n = 1$), Skype ($n = 3$), and Whatsapp ($n = 1$). Five of the participants were interviewed online, as they were in other countries. Sample interview questions are listed in Table 1.

The grounded approach was used to inductively analyse the interview data, allowing the data to generate major themes (Braun & Clarke, 2006). The first author read each interviewee's responses and categorised them into thematic units. Similar units were then categorised into potential thematic groups.

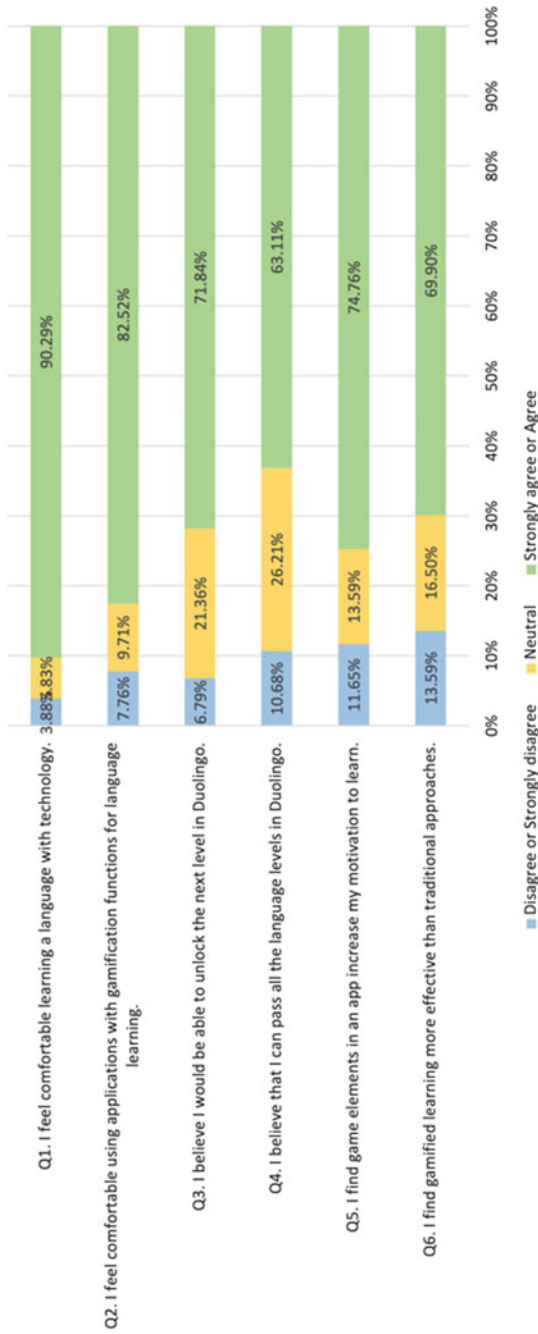


Fig. 1 Perception with gamified MALL Apps (Duolingo)

Table 1 Sample questions used in semi-structured interviews

<ul style="list-style-type: none"> • General questions: <ul style="list-style-type: none"> – How do you first start using Duolingo? Why you choose it? – How do you feel about learning a language through the gamification application by yourself?
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<ul style="list-style-type: none"> • Impact and perceived deeply influential game elements <ul style="list-style-type: none"> – Do you think of Duolingo is useful for your target language learning? How did it influence your opinion or view about language learning? – Which part in Duolingo you think is the most helpful for your language learning process? – Do you feel able to be familiar using with Chinese through Duolingo? Why or why not?

4.3 Gamified MALL Platform: Duolingo

Duolingo is one of the most downloaded free language learning apps on the app shop for mobile devices, offering 39 language courses for language learners. Originally created in 2011 by Professor Luis Von Ahn and his graduate student Severin Hacker, it aims to be a personal tutor that learners can call on anytime and anywhere, providing personalised language learning guidance and reducing their learning stress through gamified settings (Duolingo, 2020).

According to the official report from Duolingo (Duolingo, 2020), CSL learners are one of the fastest-growing clusters of learners on the platform in terms of the number of users worldwide. However, why CSL learners choose to use Duolingo to learn Chinese, what their perceptions are regarding the setting of using game elements in Duolingo to enhance learner motivation, and whether the gamified elements are conducive to enhancing their motivation are the main reasons why we chose Duolingo as the exploration instrument for this study. In this study, we divided the gamified elements in Duolingo into game mechanics (i.e., storyline, challenge and progress bar) and game dynamics (i.e., reward system and competition), based on the concepts proposed by Bunchball.

Storyline, is mainly reflected in the design of Duolingo's language courses. Duolingo designs different themes based on some common life scenarios to provide CSL learners with an immersive learning experience and facilitate a better understanding of the meaning of Chinese characters and words.

Challenge, as reflected in Duolingo's skill tree system, is a gradual process of progressive challenge. In other words, learners must overcome progressive barriers before they can move on to the next task challenge. In addition, successful challenges give L2 learners a sense of achievement, which in turn has a positive impact on learner engagement.

Progress bars, also known as the experience value, is used to show the learner's current achievement and to help visualise their completion, and it is useful to help learners with self-evaluation and self-reflection.

Rewards, there are two reward mechanisms in Duolingo, namely gold coins and badges. Once L2 learners complete a task, they are automatically awarded different amounts of gold coins depending on the difficulty of the task, which they can use

to unlock tasks on other topics or to buy other language courses on the Duolingo marketplace. The badge is a special type of performance goal setting that asks learners to think about how to complete specific tasks effectively in order to earn different meaningful badges.

Competition, which in this study refers specifically to the leaderboard, is a mode of competition designed to stimulate and increase learner engagement through social pressure.

5 Finding

5.1 *Descriptive Statistics of Respondents and Variables*

There were two phases of data collection in this study, quantitative data (questionnaires) and qualitative data (observations and interviews). The main purpose of the first phase using questionnaires was to discover some basic information about L2 learners using technology (gender and age) and their general perceptions of the gamified MALL application, and to identify potential respondents for the second phase of qualitative data collection. A total of 103 valid responses were obtained during this phase.

In our survey, we used six items to examine learners' attitudes towards technology-assisted L2 learning and their perceptions of the use of gamified MALL applications. The main aim was to investigate L2 learners' perceptions of gamification and game elements by examining the impact of Duolingo on their learning interests, motivation and perception. The overall results were positive, with over half of the participants having a positive view of the use of the gamified MALL approach. 90.29% ($n = 93$) of the participants agreed or strongly agreed that the technology-assisted L2 learning experience was comfortable, 82.52% ($n = 85$) agreed or strongly agreed that the gamified MALL approach was enjoyable for them, and 69.90% ($n = 72$) of participants felt that the gamified learning approach was more effective than the conventional approach. Regarding the gamification setting in Duolingo, 71.84% ($n = 74$) of the participants were confident that they would be able to unlock the next level of Duolingo and 63.11% ($n = 55$) felt that they would be able to successfully challenge all language levels. In addition, 74.76% ($n = 77$) of participants felt that the game element was beneficial in increasing their learning motivation.

Overall, in the first phase of quantitative data collection we found that users of technology-assisted L2 learning were mostly younger adult learners, while the participants' perceptions towards the gamified language learning pattern were positive, similar to the findings in many studies (Flores, 2015; García Botero et al., 2019; Rachels & Rockinson-Szapkiw, 2018).

5.2 *Participation Perception Towards Duolingo*

Based on the above findings, it is evident that L2 learners are interested in the general gamified MALL approach, but their perceptions of the different game elements need to be further explored. To address this, potential respondents (informal CSL learners) were screened based on the survey and emailed to ask if they would be willing to participate in the second phase of the observational study. Four criteria were used to screen potential respondents namely, (1) adult learners with full-time employment; (2) non-native Chinese learners; (3) ability to understand English; and (4) willingness and ability to use mobile devices to download and use Duolingo. A total of seven respondents volunteered to participate in the second phase of the study and six completed all interviews. The textual data for the second phase was mainly sourced from semi-structured interviews conducted once a week. The semi-structured interviews focussed on three main themes, namely overall review, impact and perceived deeply influential game elements, and these are listed in Table 2.

The grounded approach (Braun & Clarke, 2006) was used to analyse the semi-structured interviews. First, the first author read through all the interview data to obtain an overall picture of the responses and coded the data. Then, data with similar coding were grouped to form themes. Finally, we randomly selected 50% of the student interview responses and an independent researcher was included to code the responses. The inter-coder agreement were 94%. Disagreement were discussed by the two coders.

At the beginning of the interview, three of the six interviewees stated that they learnt Chinese as their partner was Chinese and they were motivated by the desire to be able to communicate with their partner's family on a daily basis in the future. Three respondents were motivated by an interest in Chinese culture because they had lived in China. All six respondents said that none of them could attend a structured language course because they had full-time jobs. They wanted a more relaxed learning environment and flexible study time because they were interested in learning Chinese and not for academic achievement. At the same time, they did not want to pay a lot of money. For the gamified MALL application, all interviewees felt that this learning approach provided them with flexibility in terms of time and place, and reduced their stress in terms of learning and money.

However, during the four-week short study period, all learners felt that the game elements enhanced their learning motivation. In particular, storyline and rewards acted as external motivators, promoting learners' learning motivation and concentration. The leaderboard, as a game element that learners used to compare themselves with others, stimulated their sense of competition, thus promoting completion and persistence.

For the CSL learning experience, as we mentioned earlier, one of the inevitable issues in CSL learning is the problem of learning Chinese characters (words with multiple meanings). All six interviewees said that Duolingo was beneficial in helping them improve their understanding and use of Chinese characters. This is because Duolingo provides learners with learning blocks on relevant topics based on the

Table 2. Summary of interviewees' perceptions of gamified MALL

Major themes	Representative quotations	No
<i>General perception</i>		
<ul style="list-style-type: none"> • Learning motivation <ul style="list-style-type: none"> – Influence from partners – Interest in Chinese culture 	<p>'I am learning Chinese based on interest and I hope to be able to chat with my girlfriend's family in the future... A formal Chinese course is a big expense and I prefer the free option because I only need to learn the vocabulary and then I can practice with my girlfriend.' (Interviewee 1)</p> <p>'It almost from the exotic interest and cultural relevance. I lived in China before, and I was interested in the culture.' (Interviewee 4)</p>	3
<ul style="list-style-type: none"> • Reasons for choosing Duolingo <ul style="list-style-type: none"> – Relaxed learning environment – Flexible schedule 	<p>'I prefer to learn the language in a completely relaxed environment because I'm already busy every day and I don't want to be forced to do something after work.' (Interviewee 3)</p> <p>'I think I more prefer learning language in a more confident environment, and Duolingo is an application I can use whenever and wherever ... I think the game element makes the Chinese learning process very enjoyable.' (Interviewee 4)</p>	6
<i>Impact of game elements</i>		
<ul style="list-style-type: none"> • Instant feedback <ul style="list-style-type: none"> – Becomes more concentrated 	<p>'Points and badges act as a form of feedback that you get immediately when you complete a task. It will tell you what you did well and where you should pay more attention The leaderboard is useful to push me to learn more and get more points because I want to be top 1.' (Interviewee 3)</p> <p>'I am very excited to be able to learn and use the language in different virtual environments... when I receive badges or points, it is shown that I achieve something with small steps, it helps me to stay motivated and keep learning.' (Interviewee 5)</p>	5
<ul style="list-style-type: none"> • A sense of achievement <ul style="list-style-type: none"> – Reduces the potential for dropout 	<p>'It's like you're challenging yourself all the time. When you complete a level, the system gives you some points and gives another challenge.' (Interviewee 3)</p> <p>'Earning points and badges dose encourage me to study the language more. Because I want to get a higher point and more badges.' (Interviewee 4)</p>	5
<ul style="list-style-type: none"> • Life-related learning scenarios <ul style="list-style-type: none"> – Improve understanding of Chinese characters 	<p>'I can choose the topic I want to learn about, for example 'culture', and then I will learn vocabulary related to 'culture' while the system tests me repeatedly. When I can fully understand the vocabulary, I can be challenged to learn more vocabulary about 'culture' Although I only use it for 5 or 10 min a day, I really think it helps me to recognise and become familiar with Chinese vocabulary.' (Interviewee 1)</p>	4

(continued)

Table 2 (continued)

Major themes	Representative quotations	No
<ul style="list-style-type: none"> A specific and clear learning goal 	<p>'I really like the way that Duolingo keeps track of how many days you've studied in a row... more the longer I study, the more motivated I become to keep my streak. So the streak system is very good for motivating you to maintain it. (Interviewee 2)'</p> <p>'I keep using Duolingo every day to make sure I can achieve my goal of a winning streak. (Interviewee 5)'</p>	5
<ul style="list-style-type: none"> Self-monitoring 	<p>'The points and badges are an achievement as you only receive rewards for completing challenges and it helps me to stay motivated and keep learning. As I can see my grade always. Obviously, everybody always wants to get a better grade.' (Interviewee 1)</p>	3
<i>Negative perceptions</i>		
<p>Unable to correct pronunciation</p>	<p>'I admit that it can help me understand better what Chinese means and how to write, but it cannot replace the traditional face-to-face teaching method. Because we have to practice pronunciation more, which Duolingo cannot provide.' (Interviewee 1)</p> <p>'Chinese is really hard for me to pronounce. But the pronunciation system on Duolingo cannot correct my pronunciation. Even if I could practice on my own, I can't correct my pronunciation on my own because I know my pronunciation is always wrong... I don't really care about the leaderboard rankings as I don't have many study partners on Duolingo.' (Interviewee 5)</p>	2
<p>Competitive pressures may reduce learning motivation</p>	<p>'I chose Duolingo because it's like a game and I can learn in a relaxed environment after work. But if I have to compete with others, I may have to spend more time and feel more stressed.' (Interviewee 4)</p>	5

Note No. indicates the number of students who made a comment on each theme

common life scenarios, such as culture, food, colours, animals and so on. This means that learners are provided with a virtual learning environment on the topic, which is what we term the 'storyline' mechanism. Meanwhile, the challenge questions are not only based on new knowledge but also on what has already been learned, which neutralises the difficulty of the challenges. Learners can choose content based on their interests first, which helps to increase their learning motivation and thus their learning persistence. In addition, the virtual learning context of the storyline provides an immersive atmosphere for Chinese learners, which helps them to better grasp the meaning of Chinese vocabulary. In addition, a moderate level of challenge helps to increase learners' self-confidence while promoting their engagement (Flores, 2015).

Alongside language skills, interviewees felt that the game element helped them to set a goal and to develop self-directed learning skills. An example of this is the winning streak in Duolingo, which is both a challenge and a process tracker and a reward game element. Once a learner wants to start a winning streak challenge, the learner must set a goal (points) for themselves, but the number of points will increase over time. Learners need to earn their target points every day through learning and challenges, and if they don't reach it one day then the points they have accumulated will go to zero. Learners therefore need to plan their learning goals and schedule their study time each day before deciding to start a winning streak. In addition, when a learner starts a winning streak, the winning streak badge will be highlighted on their profile and the points earned will be used to rank on the leaderboard. This allows learners to check whether they are achieving their learning goals by having their badge lit up at any time, which helps them to self-management and controls their learning progress.

However, during the interviews we also found that informal CSL learners' perceptions of gamified MALL were not entirely positive and that gamification was not a panacea for increasing their motivation. Two interviewees felt that a gamified MALL approach was beneficial to facilitate their motivation, but that it could not replace traditional language education. This is because for Western language learners, learning Chinese is a challenge, not only in terms of understanding the meaning of words, but also in terms of mastering pronunciation. The gamified MALL approach helped them to understand the meaning of Chinese characters and how to write it, but they did not perceive it to be able to improve their pronunciation. Also, only one respondent found the leaderboard to be helpful in his learning motivation, but not in a competitive way; he simply perceived the top ranking as proof of his learning achievement. Other respondents felt that the ranking was not motivating for them because they did not have many study partners and they studied Chinese because they were interested. One respondent even said that he did not want to use the leaderboard because it would put him under pressure to learn.

'The leaderboard is useful to push me to learn more and get more points because I want to be top 1.' (Respondent 3)

Overall, we found from the respondents' responses that game mechanics (e.g., storylines) facilitated CSL informal learners' acquisition of Chinese characters, and that the game dynamics (e.g., rewards) motivated them, as well as fostering their

independent learning skills (e.g., challenge and progress bar), thus reducing the risk of abandoning their Chinese learning. However, gamification is not a panacea; for example, competition may have a negative impact on their learning motivation.

6 Discussion

In general, the quantitative data results indicate that CSL adult language learners have a positive attitude towards the gamified approach to MALL, which is similar to the findings of gamification studies in other languages (Flores, 2015; García Botero et al., 2019; Loewen et al., 2019). Further interviews revealed that all six informal CSL adult learners found the game mechanics in Duolingo (i.e., challenges, rewards, progress bars and leaderboards) to be beneficial in increasing their motivation and helping them to develop their self-directed learning skills. However, we also found that although each participant's initial intrinsic motivation was almost identical, their learning motivation evolved as different game elements were introduced, such as for the sense of achievement (rewards) and the game experience of upgrading and fighting (challenges). Furthermore, although six respondents improved their motivation through the gamified setting, half of them said that they did not perceive a significant improvement in Chinese pronunciation and did not perceive that the gamified MALL mode had a significant impact on performance improvement.

This study found that gamification helped informal CSL learners to be motivated to learn Chinese using the MALL approach and helped them to develop goal setting, self-directed learning skills. Several reasons contributed to this positive effect.

Firstly, challenges in the game mechanics, such as the winning streak challenge, act as a goal marker to help learners set a clear and specific goal and increase their persistence by reminding them to complete their daily learning tasks. The reward badge for a winning streak is also a form of positive feedback that validates the learner's achievement as it is awarded to the learner for consistently completing the daily goal (Antin & Churchill, 2011). This positive feedback helps to reinforce the learner's self-confidence, thus increasing the probability of that behaviour occurring again (Skinner, 1989). Because the learner has a sense of achievement and their intrinsic needs are met, this promotes intrinsic motivation, which triggers the occurrence of the learning behaviour and higher levels of engagement (Deci & Ryan, 2000). That is, learners are likely to take the initiative to engage in more activities and complete more difficult challenges. Also, progress bars provide learners with the opportunity to self-monitor their progress, which helps learners to self-control their learning progress (Zhu & Bonk, 2019). This is because progress bars allow learners to check their progress at any time to assess their current achievements and how close they are to reaching their goals, thus enabling them to adjust their learning plans and refine their learning goals.

Secondly, the storyline in this gamified L2 application provides learners with different virtual scenarios, while learners can select learning topics through their own preferences. This facilitates increased intrinsic motivation as learners have the

opportunity to exercise their sense of autonomy (Sailer et al., 2017). And although there is extensive empirical evidence that rewards are beneficial for learners, when learners feel forced to engage in learning activities, they feel a lack of competence and control and their intrinsic motivation decreases (Hanus & Fox, 2015). Furthermore, Koivisto and Hamari (2014) found that learners' motivation decreases over time. In contrast, the storyline setting provided learners with life-relevant learning scenarios and allowed learners to use experience points to unlock multiple learning topics once they had gained a certain number of experience points. In other words, when CSL learners become bored with the topic they are studying, they can use the experience points they have gained to unlock another interested topic, which helps to keep learners motivated. However, if learners do not have enough experience value to open a new topic, they will target the number of experience points required to open the new topic as their new goal.

Thirdly, the challenge mechanism in this gamified app has different levels, and learners can choose the level of effort they are willing to put in depending on their circumstances. For example, when CSL learners choose to start a winning streak, they can set a learning goal (experience point) that they feel is achievable based on their assessed competence. This has the opportunity to develop learners' sense of self-management and self-control. Meanwhile, when learners have the opportunity to exercise a sense of autonomy, correctly assess their competence and be rewarded for it, they feel that they are being recognised for their competence, which motivates them to perform (Deci & Ryan, 2000).

Finally, although empirical evidence supports that the use of competitive game elements (leaderboards) may influence learners' intrinsic motivation (e.g., (Christy & Fox, 2014), in the present study, the role of leaderboards did not seem to provoke a process of social comparison and even led to a negative effect on learner motivation (Christy & Fox, 2014; Hanus & Fox, 2015). Because interviewees indicated that they were motivated to learn Chinese primarily by their interest in the language and that they did not have enough study partners, the leaderboard was perceived more as an endorsement of their achievement. Also, adult learners use the informal language learning approach because they want to learn in a relaxed and enjoyable learning environment, and excessive comparisons can increase their learning stress and thus reduce intrinsic motivation.

7 Conclusion and Limitation

Quantitative survey data show that L2 learners have significantly positive perceptions towards the use of gamified MALL approaches. Qualitative textual data also show that for informal CSL learners, the game elements are beneficial in encouraging active participation in Chinese learning and developing their self-directed skills. It also helps informal CSL learners to deepen their understanding of Chinese vocabulary. However, in terms of language skills, most learners felt that Duolingo could not help

them to fully master Chinese and that they needed more practice with native Chinese speakers. However, the results were mostly positive regarding the game elements.

Limitations of this study include the small sample size, the short study duration and the restricted subjects - informal CSL learners, which reduces the generalisability of the findings. In addition, the six respondents who completed further research were all male between the ages of 25 and 35, which limited the investigation of gender and age in the study. In particular, gamification may have a more positive impact on male learners in terms of gender, as most men enjoy playing games. A future research question may be the perception of female participants on the game element of the gamified MALL application.

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An Exploration of Developing ICT-Related Pedagogical Strategies in the Professional Development of EFL Teachers in Vietnam



Tuyen Van Nguyen , Helena Hingwa Sit, and Shen Chen

Abstract In the ever-changing educational environment, the application of information and communication technology (ICT) continues to emerge as an urgent trend for teacher educators in all subject areas. This has never been more so the case until the Covid-19 crisis, which has seen a massive push for online learning as students, teachers, and school communities everywhere have been forced to adapt to unprecedented challenges as a result of the pandemic. Recent studies reveal that in-service K-12 English as a foreign language (EFL) teachers are facing a pedagogical problem of how to use ICT to teach their students in Vietnam. Consequently, preparing in-service teachers for ICT skills in the “new norm” due to the global pandemic is urgently needed. This paper attempts to explore effective pedagogical strategies for ICT-related EFL teacher professional development (PD) in the current Vietnamese education context. It aims to identify which factors should be taken into account when an ICT-related teacher training program is implemented. Qualitative-oriented research methods using meta-synthesis and document review were employed in this study, revealing five important factors that are explored in this paper. The study is significant in providing more insights into what effective practice-oriented pedagogical strategies are needed to facilitate teachers to enhance their ICT-related skills for K-12 EFL teachers in Vietnam. It is also anticipated that the findings will help bridge the gap between theory and practice of ICT-related teacher PD in Vietnam, and in countries where there are contextual similarities.

Keywords Professional development · Training for ICT · Policies · EFL teachers · Pedagogical strategies · Instructional design

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1 Introduction

Educational technology development in the twenty-first century has been moving at a faster rate than it has ever done before. For example, it took thousands of years for humans to invent the first cassette, followed by the CD in 1980 (Pohlmann, 1989), and then the USB flash disk, which appeared in the late 1990s (Welch & Lamphier, 2019). However, it took only mere decades for the cassette, which was invented in 1963, to be mostly replaced with new digital mobile devices such as MP3 players and by cloud-based services through the use of smartphones (Dholakia et al., 2015). This changing world, and the pace at which it is moving, is not likely to stop. Some of these devices now mostly exist as icons, such as the floppy disk, which is typically used to represent the saving of documents in word-processing apps and programs (Nayyar, 2019). Numerous studies from the existing literature have examined how education in the twenty-first century has been changing in alignment with the innovation and proliferation observed in technological science. The recent Covid-19 pandemic, in particular, has resulted in a global paradigm shift from traditional face-to-face teaching to online education. Consequently, upskilling teachers in ICT use is not simply a trend but also a must if current educational systems around the world are to continue to operate. Throughout the pandemic, it has not been possible to rely solely on traditional face-to-face classrooms to deliver teaching and learning in schools; as such, the application of ICT in education has become vital for teacher educators across all subject areas. The unprecedented outbreak of the pandemic has also meant that a great number of teachers have had to quickly learn how to deliver online teaching using technologies such as Zoom, MS Teams, Google Meet, and/or other asynchronous learning platforms. English as a foreign language (EFL) teachers and teacher trainers in Vietnam are no exception, being faced with the pedagogical problem of how to use ICT to teach EFL to K-12 students during the pandemic. This domain of knowledge needs to be updated by teachers in order to meet the requirements in their teaching contexts. Therefore, one of the solutions to the problem being implemented by the government of Vietnam is continuing teacher professional development (PD) with in-service formal training programs. However, there is currently a lack of support for EFL teacher trainers to explore pedagogical strategies for ICT-related PD training in the Vietnamese education context.

This paper aims to identify which contributing factors should be taken into account when an ICT-related K-12 EFL teacher training program is implemented in Vietnam in the current context. To answer the question, the paper attempts to present a meta-synthesis of the literature on the PD of ICT for in-service teachers in both international and Vietnamese educational contexts. The procedures include (1) the outlining of key literature on ICT-related teacher PD; (2) synthesizing literature on pedagogical strategies for ICT-related in-service teacher PD and training; and (3) proposing appropriate strategies that can help to shed light on the raised research problem.

2 Literature Review on ICT-Related Teachers' PD

2.1 *The Global Context*

The emergence of technological innovation and its proliferation in the twenty-first century has meant that teachers have had to upskill their pedagogical technological competence. “Many education ministries already understand that overhauling teacher training programs and upskilling their current teachers—in English and in other subjects—must be their top priorities” (First, 2019, p. 40). Polizzi (2020) also emphasizes that teacher training programs should be accompanied by innovative curricula and pedagogy to promote digital literacy, as echoed by Trucano (2005), who has suggested that “teacher training and on-going, relevant professional development are essential if benefits from investments in ICTs are to be maximized”, but that “the existence of ICTs alone does not transform teacher practices” (p. 35). Similarly, Philipsen et al. (2019) also highlight the need for teacher training in language teacher education.

Various models of teacher PD and training have been proposed in the literature over the years. However, some of these are considered too general to employ (Clarke & Hollingsworth, 2002; Kennedy, 2005; Neil, 1986), while others were developed for specific contexts of different countries (Khan, 2014; O’Sullivan, 2001; Warriem et al., 2014) or for teachers in other subjects (Ho et al., 2013). For instance, O’Sullivan (2001), who conducted a study in Namibia with primary teachers of English, proposed a model for in-service teacher training. Built in action research with face-to-face modality of delivery, the model entails the following process: (1) needs assessment, (2) organization, (3) determination of contents, (4) training, (5) follow-up, and (6) evaluation. While practical, one shortcoming of this model is that it overstates its generalization and translation into other contexts. Khan (2014), who suggested a three-phase model, proposed that a model of integrating ICT into teacher training programs in Bangladesh based on TPCK should be implemented in three phases: Phase 1 (Pre-service, potential teachers), Phase 2 (In-service teachers), and Phase 3 (On-going: optional). It can be argued that the three phases combined are the theoretical base of teacher PD itself. To make the model more practice-oriented, it is recommended that the three phases be elaborated so that they may facilitate practitioners to articulate its use better. Ming et al. (2010), who support smart schoolteachers’ continuing PD in and through ICT with a model based on a virtual platform, encourage users to add captions in video clips to promote more interaction. It can be argued, however, that enhancing teacher PD in and through ICT by adding captions in video clips in a virtual platform may not be a panacea.

2.2 *The Context of ICT-Related EFL Teachers' PD in Vietnam*

Since coming into being, the Doi Moi (innovation) policy has brought forth a new image of national identity, enhancing the new need for foreign language education to meet the multifaceted impacts of globalization in Vietnam. As a result, some direct policies have been breathing new life into innovation in English language teaching (ELT) in its educational system (Le & Chen, 2018).

Investment in language education, and in educational technology, has received increasing attention. In 2008, the Government of Vietnam made a decision on the teaching and learning of foreign languages in its schooling system (see No.1400/QĐ-TTg on Teaching and Learning Foreign Languages in the National Education System, Period 2008–2020). This project is worth a budget of approximately USD 446.43 billion (Le, 2019). The project is now being extended to 2025 and is commonly known as the NFLP 2025. In 2017, the Government of Vietnam approved the national project for the education sector to strengthen ICT application in management, in support of teaching and learning, scientific research, and contributing to quality education for the period of 2016–2020, with vision to 2025 (The Government of Vietnam, 2017). In 2019, the Ministry of Education and Training Vietnam released a Decree N^o 2268/CT-BGDĐT on missions and solution to education in which ICT is considered as a major solution to educational development including EFL as a subject (MoET, 2019).

As a result of the above policy, in-service English teacher training has been implemented nationwide with financial investment from annual budgets on education. In particular, the Vietnamese NFLP 2025 is regarded as having given a fresh impetus to the domain of teacher PD. The implementation of such teacher training programs entails more related research conducted in the discipline of CALL and ICT policies in Vietnam. However, most of these studies focus on higher education aspects. Whereas there is a paucity in research on K-12 ICT-related teacher PD.

Given that ICT-related educational reform in ELT is one important part of their strategic vision, the Government of Vietnam implements training for in-service teachers of English (ITE), especially within their plan of the NFLP 2008–2025. Le (2019) confirms that “80% of the total budget of US\$446.43 million for the Project was allocated to teacher training” (p. 12). As aforementioned, despite the ambitious investment on English language education and teacher training, the effectiveness of these is open to question. Research shows that ITE in Vietnam is struggling with new challenges including those related to language competencies and teaching methods (Bui & Nguyen, 2016; Doan & Hamid, 2019; Huong, 2016), when benchmarked against the Vietnamese English Teacher Competency Framework (ETCF) and other international standards. Teachers' previous study programs at their colleges and universities cannot meet the requirements in high demand of the current situation. A report by Ky et al. (2016) points out that only a small percentage of elementary, lower secondary, and upper secondary schoolteachers meet the standards of language competence required by the MoET at 37.19, 36.71, and 26.12%, respectively.

In the social-cultural context of Vietnam, a teaching position is mostly life-long tenured, and in-service schoolteachers are those who participate in training the future workforce, including pre-service teachers. Therefore, they need to be well-trained. As K-12 teachers lay the foundation for school students in future higher education, they cannot be ignored in the realm of research, which is a *sine qua non* for improvement in teacher PD and training. However, there has been little discussion about specific solutions to the matters addressed in terms of ICT-related pedagogical strategies for teacher PD. This is pertinent to current problems of in-service teachers' ICT skills. There is an urgent need to enhance Vietnamese in-service EFL teachers' ICT skills and TPACK (Mishra & Koehler, 2006) in order to ameliorate their teaching quality for the benefit of all students nationwide. Technological pedagogical knowledge, the driving force for this study, is one of the three main components of the TPACK framework by Mishra and Koehler (2006). Koehler and Mishra (2005) first introduced their framework entitled TPCK (Technological Pedagogical Content Knowledge), and "the name TPACK (pronounced "tee-pack") emerged as a substitute" for TPCK in 2007 (Thompson & Mishra, 2007, p. 38). The TPACK framework shows that content knowledge without pedagogical technical knowledge cannot guarantee quality of teaching.

In Vietnam, it was not until 2014 that a course about CALL could be found in national training programs for in-service EFL teachers. Nevertheless, there is now still a dearth of research-based pedagogical strategies regarding this issue. With a lens of an insider as teacher trainer of ICT in ELT for both tertiary and K-12 teachers in Vietnam since 2014, the first author of this study has witnessed teachers struggling with ICT skills within their training programs. This reality is aligned with the findings of many other researchers (Le & Song, 2018; Ngo, 2016; Nguyen, 2019; Pham et al., 2018) with regard to the current situation of ICT literacy of ITE in this country. The crux of the matter in the status quo of training ICT skills for ITE in Vietnam is that a study on pedagogical strategies for this field is proposed. Pedagogical strategies are defined as "policies to decide the next system action when there are multiple ones available" (Chi et al., 2011, p. 137).

Regarding ICT literacy in ELT, some researchers indicate that teachers at both higher and K-12 education sector are at a low standard level (Le & Song, 2018; Ngo, 2016; Nguyen, 2019; Pham et al., 2018). Recent literature shows that in comparison to "content knowledge, professionalism, multicultural, and classroom management dimensions" (p. 161), ICT use of K-12 teachers is rated as less competent (Nguyen & Tran, 2018). Pham et al. (2018) conclude that the ICT use of EFL teachers in Vietnam is mostly at the second level of the SAMR (Substitution, Augmentation, Modification, Redefinition) model. The second level (Augmentation) is described as teachers' ability to apply technology in teaching activities with functional improvements without being able to analyze or redesign them (Hamilton et al., 2016).

The above literature review shows that teacher upskilling is a focal point in educational curriculum policies of the Vietnamese government. To implement any training, pedagogical strategies are paramount to ensure the success of a training program. However, there has been little research on the pedagogical approaches in training ICT knowledge and skills for EFL teachers at both K-12 and higher education sectors.

Most existing research topics in the Vietnamese education context focus on ICT use for language education and educational policies on ICT implementation in higher education (Dinh, 2015; Hoang, 2015; Ngo, 2016; Nguyen, 2017, 2019; Nguyen et al., 2019; Vo, 2019). Therefore, this current study attempts to address the research lacuna in exploring effective pedagogical strategies for K-12 ICT-related in-service teacher PD and training in Vietnam.

3 Method

This research problem on pedagogical strategies for ICT-related in-service teacher PD and training was examined through a meta-synthesis review of the literature and was developed according to the criteria proposed by Toye et al. (2014). These authors suggest research procedures including (1) identification, (2) criteria and screening, (3) inclusion/exclusion, (4) reviewing, and (5) analysis and findings.

3.1 Procedures for Searching, Identifying, and Selecting Articles

To ensure that high-quality articles would be included in the meta-synthesis review, the researchers accessed the Web of Science (WoS) by Clarivate via an account provided by the University of Newcastle, Australia. The reason for employing this database is that WoS is one of the world's most reliable publisher-independent global citation databases. Table 1 below demonstrates the criteria used for data collection.

Table 1 Criteria for data selection

Inclusion	
Topic for searching	Teacher professional development
Keywords for subtopics	“Teacher training”, ICT, CALL, technology, and “digital competence”
Data sources	WoS
Time of publication	2011 to 2020;
Indexed by	SCI-EXPANDED, SSCI;
Exclusion	
Research participants	Pre-service teacher education or specific subject teachers other than English teaching
Level	Teacher PD and training at higher education sector
Time of publication	Publication prior to the year 2011

3.2 Selection Procedures for Data Analysis

When collecting data, we considered the inclusion and exclusion criteria on titles, abstracts and keywords for the initial selection. The number of articles found in total was 873 (with *ICT*, *CALL*, *technology*, and *digital competence* as keywords; the number of articles found by topic were 168, 123, 515, and 67, respectively). The search results were downloaded into an Endnote file (.enl). After the data were imported using Endnote software, we checked for duplicate articles within Endnote and removed 419 duplicates. We continued to use Endnote software and exclusion keywords (pre-service teacher, higher education) to remove irrelevant articles. After the screening, and the exclusion procedures, the number of articles that remained was 83. The data of these 83 articles were exported as an .xml file and then imported into NVivo for data coding and analysis.

4 Results and Discussion

By synthesizing articles about ICT-related in-service teacher PD in the database of WoS published in the last ten years (2011–2020), we found a fluctuation in the number of publications over the years. However, the data also showed that, in the last five recent years, the number of publications has been much higher than that of the five previous years ($n = 50$ in 2016–2020 compared to $n = 33$ in 2011–2015).

The number of publications is illustrated in Fig. 1 below.

Upon review of the 83 articles, we identified five major themes with regard to pedagogical strategies for ICT-related teacher PD. These include: (1) policies, (2) instructional design, (3) trainers’ pedagogical competence, (4) teacher trainees’ beliefs and self-efficacy, and (5) teacher trainees’ experiences.

The number of issues published by year is illustrated in Fig. 2 as follows:

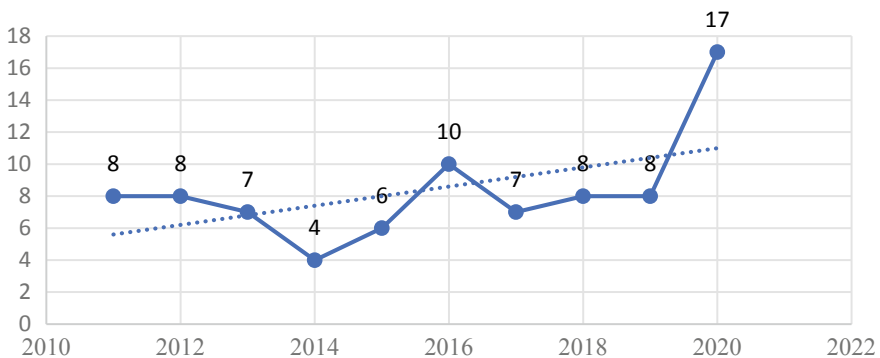


Fig. 1 Trend of publications on ICT-related PD, by year (2011–2020)

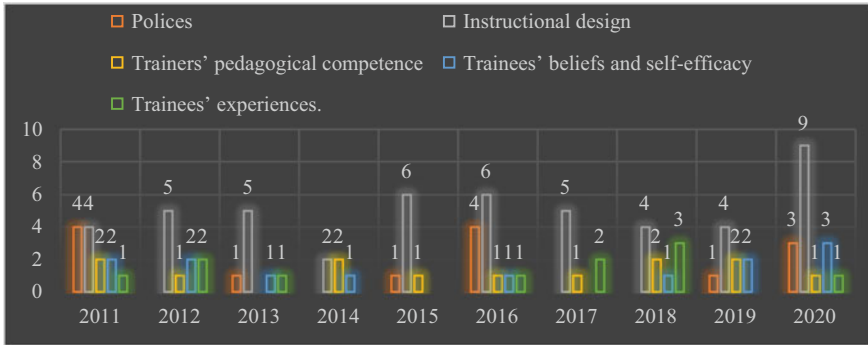


Fig. 2 Researched factors found from the papers, by year

In total, 14 papers had focused on policies, 50 on instructional design, 13 on trainers’ pedagogical competence, 13 on trainees’ beliefs and self-efficacy, and 11 on trainees’ experiences.

These research findings suggest that education policies have an impact on teacher training programs (Bond et al., 2019; Gewerc & Montero, 2013; Handal et al., 2011; Woo, 2016). Similarly, the ICT competency standards for teachers by UNESCO (2008) confirm that “teachers must understand the intentions of national policies and be able to contribute to the discussion of education reform policies and participate in the design, implementation, and revision of programs intended to implement” (p. 10). In this respect, it is revealed that top-down policies, managerial skills, and infrastructure are also crucial to the success of a teacher training program. Educational policies on EFL teachers’ PD have directly impacted the implementation of teacher training programs. For example, in Vietnam, a budget of US\$446.43 million has been invested in EFL teachers’ PD in which the fund is mostly allocated to teacher training. Without such educational, financial policies, the annual training programs of ICT skills for in-service EFL teachers would not have been implemented nationwide in this country since 2014. Managerial skills and infrastructure of an educational institution can also be affected by policies. For example, when a training program is devised with a Learning Management System (LMS) (e.g., Moodle, Blackboard or Canvas), program developers can find it much more feasible to design an online/a blended learning program to meet the need of twenty-first century students.

Instructional design emerged from this study as the most common theme, with 50 papers, e.g., (Abuhmaid, 2011; Alquraini & Rao, 2020; Antink-Meyer & Aldeman, 2020; Boloudakis et al., 2018; Brauer et al., 2019; Cabero-Almenara & Romero-Tena, 2020; Chien, 2020; Escudero et al., 2018; Fannakhosrow & Nourabadi, 2020; Fathema & Akanda, 2020; Garcia-Martinez et al., 2020; Han & Patterson, 2020; Handal et al., 2011; Heller et al., 2012; Iredale et al., 2020; Joubert et al., 2020; Navarro et al., 2016; Ploessl & Rock, 2014; Shernoff et al., 2020; Spiteri & Rundgren, 2017; Tarling & Ng’ambi, 2016; Tenekeci, 2011; van Zyl et al., 2013; Walton et al., 2014; Xie et al., 2017; Yeh & Tseng, 2019). Instructional design is defined as “the

science of creating detailed specifications for the design, development, evaluation, and maintenance of instructional material that facilitates learning and performance” (Martin, 2011, p. 956). Sit and Guo (2019) agree that, based on appropriate theoretical and practical framework, the development of dynamic teaching–learning activities can be greatly supported, and classroom interaction thereby enhanced.

The findings from this meta-synthesis of the literature show that, when considering instructional design strategies, one must take the following into account: (1) the employment of a specific model or framework, (2) modes of delivery, (3) the emphasis on the community of practice, and (4) teacher trainees’ needs. Instructional design is to be concerned with models or frameworks (Alsofyani et al., 2012; Bond et al., 2019; Bound, 2011; Ebert-May et al., 2015; Escudero et al., 2018; Masats & Dooly, 2011; Murthy et al., 2015; Navarro et al., 2016; Ploessl & Rock, 2014; Rienties et al., 2018; Shamir-Inbal & Blau, 2020; Xie et al., 2017; Yeh & Tseng, 2019; Zhang & Cheng, 2012). A model and a theory are not exactly the same in nature. The former seems to be more practice-oriented. Bhattacharjee (2012) states that, “while a theory tries to explain a phenomenon, a model tries to represent a phenomenon. Models are often used by decision makers to make important decisions based on a given set of inputs” (p. 14). We recommend choice among the four models, namely the backward design by Wiggins et al. (2005), the ADDIE by Molenda (2003), the ASSURE by Smaldino et al. (2008), and the Essential competencies of Digital and Media Literacy by Hobbs (2010), as detailed below.

First, the backward design model is practical (Wiggins et al., 2005) because it focuses on three important stages of teacher PD: identification of desired results, determination of acceptable evidence, and planning learning experiences and instruction. Incorporating these three steps can help program developers/instructors to effectively map their courses and achieve curriculum alignment.

Second, the ADDIE model (Molenda, 2003) is practical for instructional design. It includes the “analyze, design, develop, implement, and evaluate” stages. It is also suggested that “this sequence, however, does not impose a strict linear progression through the steps” (Kurt, 2019, para.1). The ADDIE model can clearly support an ICT skills training program or its course designers.

Third, the ASSURE model (Smaldino et al., 2008) incorporates six components which stands for:

- A—Analyze learners
- S—State standards and objectives
- S—Select strategies, technology, media, and materials
- U—Utilize technology, media, and materials
- R—Require learner participation
- E—Evaluate and revise.

The ASSURE model elaborates clearer stages than the EDDIE model. For example, the “A” stage is specific to the analysis of learners. This is an important step because by understanding the target participants, the instructional designer can increase the chances to meet their needs.

Lastly, the process model by Hobbs (2010) includes five stages including (1) access, (2) analyze and evaluate, (3) create, (4) reflect, and (5) act. Allison (2013) supports that this model “presents a clear and practical map for coalescing and building on the many digital and media literacy programs” (p. 181). Sit (2021) further echoes this five-part communication competencies or dimensions of digital and media literacy should be fundamental for twenty-first century students to learn and communicate in the digital era and, for teacher educators, to engage their students in twenty-first century instruction.

It can be found from the aforementioned models that they all emphasize the importance of analyzing the contexts (especially learners’ characteristics), creating or developing teaching instruments, and evaluating the learning outcomes. These strategies are regarded as being indispensable to instructional design.

Online learning and blended learning are mostly recommended modes of delivery for in-service teacher PD in ICT skills. The emphasis on the community of practice (Cool et al., 2020; Denker et al., 2020; Hytonen et al., 2014; Iredale et al., 2020; Ozen, 2013; Rego et al., 2013; Walton et al., 2014; Zhang et al., 2016) is also meaningful to the emergence of online learning during the current global pandemic.

Although not many articles focused on this problem, the understanding of teacher trainees’ needs is of great importance (Bound, 2011; Brauer et al., 2019; Esfijani & Zamani, 2020; Li et al., 2020; Rienties et al., 2018; Tondeur et al., 2017). Darling-Hammond et al. (2017) also emphasize that regular needs assessments using data from surveys to identify areas of professional learning are most needed and desired by educators. These can help to ensure that professional learning is not disconnected from practice and that it supports the areas of knowledge and skills that educators should develop. Understanding trainees’ prior training experience, current work experience can help instructors tailor their needs, pace of instruction, amount of time to allocate a task, and more importantly to decide appropriate overall input activities in a training program. We also argue that feedback and appropriate assessment methods during and after a training program are likewise important components of instructional design.

Regarding trainers’ pedagogical competence, it is no doubt that the recruitment of a qualified trainer is indispensable (Bound, 2011; Brauer et al., 2019; Cabero-Almenara & Barroso-Osuna, 2016; Escudero et al., 2018; Fonsen & Ukkonen-Mikkola, 2019; Garcia-Martinez et al., 2020; Iredale et al., 2020; Joubert et al., 2020; Peeraer & Van Petegem, 2012; Rienties et al., 2018; Shernoff et al., 2020; Sundberg et al., 2012; Tarling & Ng’ambi, 2016; Tondeur et al., 2017). With the same policies, the same resources and trainees, training outcomes may differ as a result of different trainers’ pedagogical competence. We suggest that the pedagogical competence of trainers is one of the key factors that can affect the quality of an ICT-related teacher training program. In addition, we recommend that a program be designed based on trainees’ needs, rather than what repertoire a trainer may have.

Another strategy for enhancing ICT-related teacher PD is understanding teacher trainees’ beliefs and experiences. Most conclusions from the articles that investigated the relationship between teachers’ beliefs (or self-efficacy) and ICT use show that they are significantly correlated (Abuhmaid, 2011; Chou, 2012; Gewerc & Montero,

2013; Gudmundsdottir & Hatlevik, 2018; Han & Patterson, 2020; Kelley et al., 2020; Koc & Ozden, 2013; Power et al., 2016; Taimalu & Luik, 2019; Tondeur et al., 2017; Wong, 2016). The implication of this finding is that when designing an ICT skills training program for in-service EFL teachers, it is suggested that designers and trainers gradually help trainees make positive changes in their beliefs about the effectiveness of ICT use in their teaching. However, this will need time because it is not easy for one individual to change their beliefs, especially the unadventurous. Understanding teacher trainees' experiences can be taken into account when pedagogical strategies for ICT skill training are investigated (Fathema & Akanda, 2020; Handal et al., 2011; Tezci, 2011). With the lens of a teacher trainer of ICT skills for EFL teachers in Vietnam, one of the authors of this paper finds that when assigning a synchronous task in a training workshop, the necessary time to complete a task among teacher trainees is so diverse. Some can complete a task in about five minutes, while others undertaking the same task will require more than twenty minutes. This is often due to the fact that they had never experienced the ICT tools or program that they had been provided with. The implication is that placing teacher trainees with those at a similar level of competence can facilitate the training process. Therefore, understanding their needs remains an important pedagogical strategy.

5 Conclusion

This paper attempts to explore effective pedagogical strategies for ICT-related EFL teacher PD in the current Vietnamese education context by outlining key literature on the research problem and synthesizing the literature on pedagogical strategies for in-service teacher PD and training. To develop pedagogical strategies for K-12 ICT-related EFL teacher PD in the Vietnamese educational context, these five aspects, including appropriate policies, appropriate instructional design, recruitment of highly qualified trainers, and understanding about teacher trainees' needs, experiences, and beliefs, are closely investigated in this paper. The last pedagogical strategy related to trainees, especially the identification of their needs, is highly recommended. This enables the training program of ICT-related teacher PD to be tailor-made in their contexts.

Regarding limitations of the study, a nationwide survey about the current ICT skills of EFL teachers in Vietnam during the pandemic could offer the basis of an extended research study, providing further insight into their current experiences. It is recommended that future research that focuses on teachers' needs for their ICT-related PD be conducted, especially around issues relating to instructional design and the burgeoning bichronous mode of teaching delivery within the context of newly emerged ICT affordances in education. Despite the limitations, the study should provide more insights into what effective practice-oriented pedagogical strategies are needed to facilitate teachers to enhance their ICT-related skills for K-12 EFL teachers in Vietnam. It is also significant in raising more and more professional teacher trainers' awareness of the need to and how they could better equip their

teacher trainees with possible new educational technologies in language teaching and learning in countries other than Vietnam. It is at the reader's or practitioner's discretion to generalize the findings and application in relation to their own country's context.

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Online Learning and Blended Learning

An Adventure in Flipping a Secondary School Mathematics Classroom During the COVID-19 Pandemic



Man Keung Chun and Chung Kwan Lo

Abstract During the COVID-19 pandemic, schools were required to reduce face-to-face lecturing hours to minimize contact between people. To better utilize the reduced class time, we attempted to use the flipped classroom approach to teach a junior secondary school mathematics unit. After learning some basic knowledge via pre-class videos, students took part in interactive learning activities (e.g., Kahoot! quizzes) and solved more advanced problems inside the classroom. The results indicated that our students ($n = 20$) scored significantly higher in their post-test ($Mdn = 39.50$) and 2-week delayed post-test ($Mdn = 42.50$) compared to their pre-test ($Mdn = 15.00$). Although they generally supported the use of the flipped classroom approach, several students suggested that the teacher should reduce the number of the Kahoot! quizzes due to the time constraint. Based on the results, we discussed certain lessons that we learned regarding the use of the flipped classroom approach during the pandemic.

Keywords Flipped classroom · Flipped learning · Mathematics education · Secondary education · COVID-19

1 Introduction

The COVID-19 pandemic has had a global impact on education. Schools in many parts of the world have been forced to close as the number of confirmed cases rocketed. In Hong Kong, schools were required to reduce face-to-face lecturing hours by changing from whole-day schooling to half-day schooling. This measure was to minimize contact between people and thus the risk of epidemic spreading. Therefore, schools were recommended to adopt different modes of instruction, particularly

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223

e-learning, to support student learning at home. The Education Bureau (n.d.) has collated and constantly uploaded resources onto their webpage to facilitate teachers' application of e-learning. The online resources covered the use of e-learning platforms (e.g., learning management systems, online assessment tools, and web conferencing software) and the flipped classroom approach. Without doubt, the pandemic has presented unprecedented challenges to the education sector as we have never experienced such a prolonged school interruption before. How can we better support student learning during the pandemic? This study aims to address this very question.

In this study, we attempted to use the flipped classroom approach to teach a junior secondary school mathematics unit. It is a possible instructional approach that allows teachers to efficiently utilize class time and interact with students (Lo et al., 2017). Our students would learn some basic knowledge of the unit before class using instructional videos. The class time was spent on more advanced skills and resolving students' learning difficulties through the teacher's individualized feedback. However, even though face-to-face lessons were allowed during the period of half-day schooling, working in physical groups was not encouraged to maintain social distance inside the classroom. Therefore, we used interactive learning activities in the form of Kahoot! quizzes to support student engagement (Johns, 2015; Wang & Tahir, 2020). The following research questions (RQs) guided our study:

- RQ1: What are the immediate and 2-week delayed effects of the flipped classroom approach on students' mathematics achievement?
- RQ2: How do students perceive the use of the flipped classroom during the pandemic?

2 Conceptual Background

The study drew upon two major research areas, including the flipped classroom approach and game-based learning. After that, a research agenda is proposed.

2.1 *The Flipped Classroom Approach*

The flipped classroom approach is one of the popular teaching approaches in recent years and it has widely been used in mathematics education (Lo & Hew, 2021b; Lo et al., 2017). As Talbert (2017) described, under the flipped classroom approach, students first contact with new materials before class via, for example, instructional videos and online exercises. Then, teachers can spend the class time providing more interactive and advanced learning activities (Wei et al., 2020). In their meta-analytic review, Lo et al. (2017) found that flipped classroom students generally outperformed traditional classroom students with a small but significant effect size (Hedges' $g = 0.298$, $p < 0.001$). The researchers further identified various benefits of this instructional approach (e.g., on-demand accessibility of video lectures

and increased peer-assisted learning) that facilitated student learning. Compared to traditional lecturing, Lo and Hew (2021b) found that the use of the flipped classroom approach can generally increase student engagement, such as attention and course satisfaction. Therefore, the use of this instructional approach is widespread in mathematics education.

However, it is questionable to generalize the research findings under the current situation as most of the published flipped classroom studies were conducted before the COVID-19 pandemic. The use of the flipped classroom approach is also a challenge to some students and teachers. Researchers found that some students “reacted negatively to the change in their learning routines” (DeSantis et al., 2015, p. 50) and did not get used to the interactive nature of in-class learning (Larsen, 2015). For teachers, Webel et al. (2018) revealed that some teachers were not familiar with the time allocation for the instructional activities inside the classroom, which included a review of pre-class materials, hand-on exercises, and small-group activities, among others. These challenges are worth noticing when using the flipped classroom approach, especially during the COVID-19 pandemic.

2.2 *Game-Based Learning*

To enhance student engagement, some researchers incorporated game-based learning into the flipped classroom approach. For example, Hung et al. (2019) employed a “capture the flag”-style game in their 7th and 8th Grades mathematics flipped lessons. After doing some exercises, their students worked in groups to solve mathematics problems. The groups could earn points by answering the questions correctly, and then used their points to capture the territories of the other groups. The researchers found that students’ learning motivation and outcomes increased after their 2-week intervention. However, a few students expressed their concerns about this kind of game-based learning activities. In the words of one student, “I do not feel good about it because most of the time is wasted playing games” (p. 1042).

Besides engaging students in problem-solving, some game-based learning platforms can assess their learning. As Johns (2015) introduced, Kahoot! (<https://kahoot.com>) is a free website that allows teachers to create a game-based learning environment for students to play against each other. They score according to their accuracy and response time. Most importantly, teachers can assess students formatively based on their responses to the quizzes. Wang and Tahir (2020) found that the use of Kahoot! had a positive effect on learning performance, classroom dynamics, and student engagement across studies. Nevertheless, the researchers cautioned that teachers should focus on student answers, instead of timing. Otherwise, some students might simply submit a random answer promptly to get a high score more by luck than judgment.

2.3 Research Agenda

With the endless pandemic and social distancing measures, research is required to inform the practice of the flipped classroom approach in the “COVID normal” environment in which face-to-face class time and classroom interactions are reduced. Up to December 2020, however, the systematic review of Lo and Hew (2021b) had not found any empirical studies of mathematics flipped classrooms conducted during the pandemic. We therefore adopted and contextualized the research agenda of Abeysekera and Dawson (2015, p. 11) to inform future research which can advance our understandings of the efficacy and student perceptions of this instructional approach:

- Small-scale localized interventions during the pandemic: What is the efficacy of the flipped classroom approach in this subject discipline, in this classroom, and with these students?
- Qualitative work into student learning and student experiences of the flipped classroom approach during the pandemic.
- Large-scale systematic reviews of the flipped classroom research during the pandemic.

In the initial stage, small-scale interventions are recommended because researchers are yet to have a solid grounding to support the use of the flipped classroom approach during the pandemic. As discussed above, the use of this instructional approach can be a challenge to students and teachers (DeSantis et al., 2015; Larsen, 2015; Webel et al., 2018). This small-scale study thus allows us to testify its application in the “COVID normal” environment with minimal risk to our student participants. Qualitative work (e.g., interviews) will enable researchers to gain an in-depth understanding of participants’ experiences and perceptions in authentic contexts. The empirical findings will thus contribute to informing future practice of the flipped classroom approach. Following Abeysekera and Dawson (2015), we recommend large-scale systematic reviews be conducted in the future to understand teacher and student experiences across contexts.

3 Research Methods

3.1 Research Context and Participants

This study was conducted in a secondary school in Hong Kong during the COVID-19 pandemic (November 2020), involving 20 Grade 7 (i.e., Secondary 1) students. A final year pre-service teacher (the first author) designed and implemented the flipped classroom intervention under the guidance of a teacher supervisor in the research school. The duration of the intervention was 2 weeks, teaching a mathematics unit called “linear equations in one unknown.”

The research school had made some special arrangements in response to the pandemic. First, all face-to-face classes were conducted on a half-day basis. Therefore, the duration of each lesson was reduced to 40 min. Second, the school maximized space between desks inside the classroom, maintaining a minimum of 1.5 m between student chairs. Under this learning environment, student–student interactions as in a traditional classroom were not feasible.

3.2 The Flipped Classroom Design

The flipped lessons were designed based on the existing studies (Lo et al., 2017; Talbert, 2017). At the start of the intervention, we introduced our students to the concept of the flipped classroom approach and the use of Google Classroom—our learning management system. First, the students learned some basic knowledge (e.g., the basic idea of linear equations in one unknown) before class via instructional videos (about 5 min in length). Video guides were provided to facilitate their note taking. Furthermore, they were required to complete several questions and upload the worksheet to Google Classroom for teacher checking. Thus, the teacher could monitor students' pre-class learning with further adjustment on the subsequent lesson plan based on student performance. The estimated pre-class time of each lesson was about 20–30 min.

When coming back to the classroom, the teacher first clarified students' misunderstandings as revealed in the online questions (10 min). More advanced knowledge was then discussed, such as some advanced skills of solving linear equations in one unknown (10 min). After that, the students were engaged in problem-solving activities (10 min). The teacher circulated around the classroom and provided guidance when necessary. At the time of our intervention, we allowed short discussion in pairs without using small-group activities due to the social distancing measures. Instead, we used Kahoot! quizzes to engage students in problem-solving and assess their understandings of course materials (10 min). Based on the quiz results, the teacher would provide feedback on student performance. Figure 1 show a snapshot of one Kahoot! quiz.

3.3 Data Collection and Analysis

Figure 2 overviews our research design and data collection. The three major data sources collected in this study were (1) tests, (2) a student survey, and (3) participant interviews.

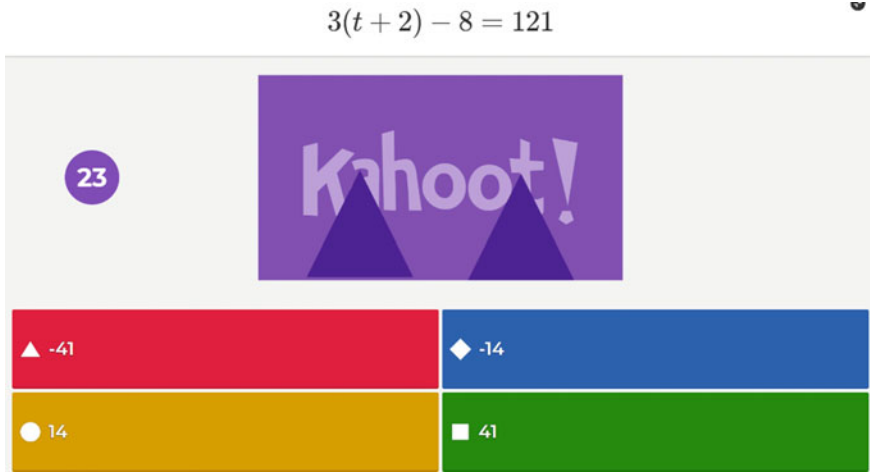


Fig. 1 A Kahoot! quiz about linear equations in one unknown

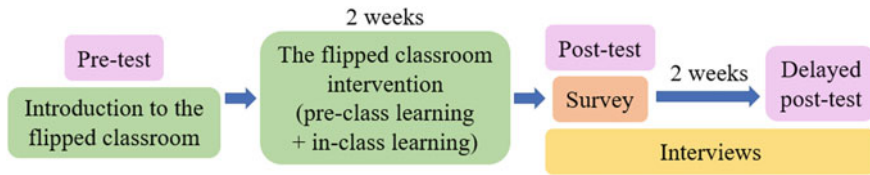


Fig. 2 Research design and data collection

3.3.1 Tests

To answer RQ1, a pre-test, immediate post-test, and 2-week delayed post-test were conducted to assess students’ mathematics achievement. In particular, the delayed post-test was used to examine whether student learning could sustain after 2 weeks. Each test lasted for 25 min with a possible range of scores from 0 to 50, comprising of basic questions (40%), advanced questions (30%), and word problems (30%). The questions in the three tests were different but similar in terms of the scope and difficulty level. Table 1 shows several questions of the pre-test for an illustration.

To analyze if there were differences in scores between the three tests, a Friedman’s ANOVA (a non-parametric test for comparing the differences between several related datasets) was conducted at a significance level alpha of 0.05 (Field, 2009). This non-parametric test was used because the results of a Kolmogorov–Smirnov test indicated that the pre-test and delayed post-test data violated the normality assumption. When significant differences were found, multiple Wilcoxon signed–rank tests were run as non-parametric post hoc procedures for pairwise comparisons. As Field (2009) suggested, however, Bonferroni correction had to be applied to avoid making Type I errors. Therefore, all the effects of the post hoc analysis were reported at a 0.05/3

Table 1 Questions in the pre-test

Item No.	Question type	Question
3	Basic	Solve the following expression $4a + 8 = -4$
6	Advanced	Solve the following expression $\frac{3d}{5} - \frac{5d}{6} = -7$
8	Word problems	Sam has some \$2 coins and 8 \$5 coins in his wallet. If the total amount of money is \$54, find the number of \$2 coins in his wallet

= 0.0167 significance level. “To discover whether our effect is substantive,” as Field (2009, p. 341) suggested, we calculated the effect size (r) using the following formula (pp. 579–580):

$$r = \frac{z}{\sqrt{N}},$$

where z is the z -score and N is the total number of student participants in the two datasets. The benchmarks for effect sizes are 0.1, 0.3, and 0.5 indicating a small, medium, and large effect, respectively (Field, 2009).

3.3.2 Student Survey

To answer RQ2, a student survey was designed to understand students’ general perception of the flipped classroom approach. They were given 10 min to complete the survey at the end of the intervention. A 5-point Likert scale was used, ranging from 5 for “strongly agree” to 1 for “strongly disagree.” Due to the limitation of space, we reported five (e.g., “I prefer the flipped classroom approach to traditional lecturing”) out of 20 survey items in this paper. We presented the descriptive statistics of the survey results (see Table 3).

3.3.3 Participant Interviews

We further invited the teacher supervisor and randomly selected five students (25% of the student participants) for an interview. The semi-structured interview approach was employed to seek an explanation of the quantitative results (Creswell & Plano Clark, 2011). In the interview of the teacher supervisor, we probed for his comments on students’ test performance. As for the student interviews, an interview protocol was developed to understand (1) their perception of the flipped classroom approach and (2) the benefits and challenges under this instructional environment.

The interview data were analyzed using the procedures of Creswell (2012), which allowed us to identify and provide insights from the data. Some of the data were translated from Chinese into English for reporting purposes.

4 Results

4.1 RQ1: What Are the Immediate and 2-Week Delayed Effects of the Flipped Classroom Approach on Students' Mathematics Achievement?

Figure 3 shows the boxplot of students' ($n = 20$) scores across the pre-test, immediate post-test, and 2-week delayed post-test. The results of the Friedman's ANOVA indicated significant difference between the three tests, $\chi^2(2) = 29.85, p < 0.001$.

A series of Wilcoxon signed-rank tests were used for pairwise comparison. Table 2 shows that compared to their pre-test ($Mdn = 15.00$), our students scored significantly higher in their post-test ($Mdn = 39.50$), $T = 209, p < 0.001$, with a large effect size $r = 0.61$, and in their delayed post-test ($Mdn = 42.50$), $T = 210, p < 0.001$, with a large effect size $r = 0.62$. However, the difference between the post-test ($Mdn = 39.50$) and delayed post-test ($Mdn = 42.50$) was not significant, $T = 108, p = 0.33$.

The teacher supervisor provided explanations on student performance of the three tests based on his understanding of the class. Regarding their underperformance in the pre-test, he lamented that "The students were unfamiliar with the topic of the linear equations in one unknown and their mathematics ability was relatively

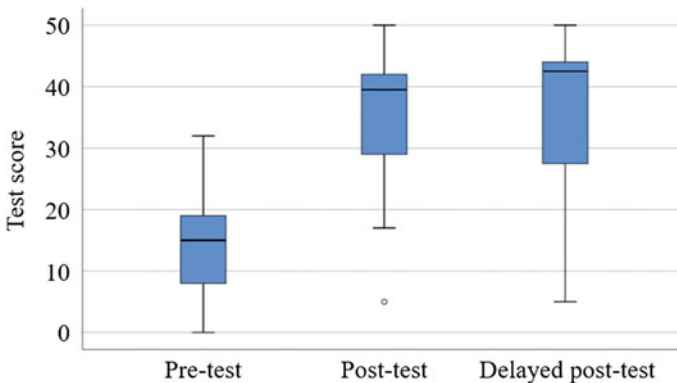


Fig. 3 Boxplot of students' ($n = 20$) scores by test

Table 2 Students' ($n = 20$) test results and pairwise comparison

Test	M (SD)	Mdn	Pairwise comparison (effect size)
Pre-test (T_0)	13.60 (8.42)	15.00	
Post-test (T_1)	35.25 (11.52)	39.50	$T_1 > T_0$ *** ($r = 0.61$)
Delayed post-test (T_2)	36.90 (11.99)	42.50	$T_2 > T_0$ *** ($r = 0.62$)

*** $p < 0.001$

low.” In the post-test, “Their performance increased dramatically, reflecting that most students have acquired the knowledge and skills of solving the linear equations in one unknown after the flipped classroom intervention.” He added that, however, “The change between the post-test and delayed post-test results was not significant because they might not start their revision for the [first-semester] exam.”

4.2 RQ2: How Do Students Perceive the Use of the Flipped Classroom During the Pandemic?

We used a post-intervention survey and interviews to examine student perception of the flipped classroom. As shown in Table 3, the results of the survey were not overwhelmingly positive. For example, although half of the students agreed (30%) or strongly agreed (20%) that they were more engaged in the flipped classroom, others (50%) rated neutrally (Survey item 3). Similarly, only half of the students expressed their agreement (35%) or strong agreement (15%) to the statement of “I prefer the flipped classroom approach to traditional lecturing” (Survey item 4).

In the student interviews, our students expressed diverse views on the use of Kahoot! quizzes inside the classroom. Three out of five student interviewees enjoyed doing the Kahoot! quizzes. For example,

- “Through the Kahoot! [quizzes], I felt happy, excited, and more engaged in the lessons because I had to answer the questions within a time limit.” (Student 2)

Two students, however, did not agree especially when the face-to-face lecturing hours were limited during the pandemic. In the words of the following students,

- “Class time should be serious and normal. The class became noisy when using Kahoot! [quizzes]. This impaired the classroom norm and learning atmosphere.” (Student 3)

Table 3 The results of the student survey ($n = 20$)

Survey item	SA (%)	A (%)	N (%)	D (%)	SD (%)
1. I felt confident to follow the in-class learning activities after pre-class learning	15	50	25	5	5
2. I had more time asking questions and receiving teacher’s feedback	15	55	30		
3. I was more engaged in the flipped classroom	20	30	50		
4. I prefer the flipped classroom approach to traditional lecturing	15	35	50		
5. Compared to traditional lecturing, the flipped classroom approach is more effective	15	40	45		

Abbreviations: SA = strongly agree, A = agree, N = neutral, D = disagree, SD = strongly disagree

- “The teacher should not add too much e-learning activities into the lessons because the lessons should be formal.” (Student 4)

Nevertheless, Table 3 shows that more than half of the students agreed (15%) or strongly agreed (50%) that they felt confident to follow the in-class learning activities after pre-class learning (Survey item 1). As Student 5 explained in the interview, “Watching the instructional videos before class helped me follow and understand the in-class learning materials... and thus reduced distractions during class.” Besides, more than half of them (agree = 55%; strongly agree = 15%) perceived that they had more time asking questions and receiving teacher’s feedback (Survey item 2). Clearly, presenting some course materials via instructional videos had freed up class time for teacher-student interactions. Besides that, the view of Student 5 provided an explanation related to the use of the Kahoot! quizzes: “The in-class activities enhanced the communication and interactions between the teacher and students. If most of the students had got a wrong answer, the teacher would pause the game and explain the question to the whole class.”

5 Discussion

In this study, we used the flipped classroom approach with game-based learning to teach linear equations in one unknown in a Grade 7 mathematics class. We discuss the results of student achievement and perceptions in the following subsections. After that, we acknowledge several limitations of the study and provide recommendations for future research.

5.1 Increased Student Achievement in the Post-test

Compared to the pre-test, our students scored significantly higher in their post-test, with a large effect size. The teacher supervisor confirmed the efficacy of the flipped classroom approach. In his view, the mathematics ability of the students was low in general. According to Bhagat et al. (2016), the use of this instructional approach was particularly effective in helping low achievers in learning mathematics. The researchers explained that the students could re-watch their instructional videos to gain a better understanding of course materials before class. Besides, the low achievers could receive more attention and guidance from the teacher to support their learning. These benefits echoed with the general perceptions of our students as indicated in the results of Survey items 1 and 2 (see Table 3).

In mathematics education, preparing students for class (Survey item 1) and providing them with more teacher feedback (Survey item 2) are the core values of the flipped classroom approach related to student learning (Lo et al., 2017). As McGivney-Burelle and Xue (2013) explained, the pre-class learning activities could

prompt students to understand the big picture of what they would learn in the coming lesson. Inside the classroom, the teacher had more opportunities to speak with each student and address their unique learning problems (Clark, 2015). With these positive results, this study has established grounds for researchers to conduct large-scale flipped classroom interventions with a longer duration during the pandemic.

The result of the increased student achievement resonated with other flipped classroom research in secondary school mathematics education before the pandemic. For example, Kirvan et al. (2015) examined whether the use of this instructional approach could enhance student learning of linear equations (a Grade 7–8 mathematics topic). The results of their pre-test ($M = 0.44$, $SD = 0.24$) and post-test ($M = 0.85$, $SD = 0.22$) suggested that student ability of solving these mathematical problems increased after the intervention, with a significantly large effect size ($d = 1.74$, $p < 0.001$). It is worth noting that, however, the control group (i.e., traditional lecturing) of Kirvan et al. (2015) also had a better performance in their post-test ($M = 0.68$, $SD = 0.25$) compared to their pre-test ($M = 0.39$, $SD = 0.24$), with a significantly large effect size ($d = 1.16$, $p < 0.01$). In other words, further research involving a control group is required if researchers want to determine whether the flipped classroom approach is superior to traditional lecturing during the pandemic.

5.2 *Non-significant Difference Between Students' Post-test and Delayed Post-test Scores*

Despite the significant increase from the pre-test to the post-test scores, our students performed statistically the same in their post-test and 2-week delayed post-test. If we look at this result in a positive light, their mathematics achievement could sustain over 2 weeks. In the literature, very few studies employed a delayed post-test to examine the sustainability of student learning in secondary school mathematics flipped classrooms. We found one study by Toh et al. (2017) in a Brunei girls' high school. The researchers used a pre-test, post-test, and 2-week delayed post-test in two out of their three action research cycles. Similar to the results of this study, they found that the differences in student scores between their post-test (Cycle 1: $M = 79.81$, $SD = 9.89$; Cycle 2: $M = 65.31$, $SD = 10.91$) and delayed post-test (Cycle 1: $M = 81.63$, $SD = 10.21$; Cycle 2: $M = 75.00$, $SD = 9.57$) were not significant in the two cycles. Yet, the researchers pointed out that the flipped classroom approach had already had a positive impact on student performance with reference to their pre-test scores.

However, the teacher supervisor expected that our students should have performed better in their delayed post-test. In his view, the students did not improve because they had not started their revision for the first-semester exam. Ideally, the online resources (e.g., instructional videos) could help students review the course materials before tests. For example, Peterson (2016) found that his students started re-watching their instructional videos a week before their statistics exam. However, they had a relatively high learning motivation probably because they were college students. To

engage secondary school students in learning tasks, one possible strategy is the use of game-design elements, such as badges, digital points, and a leaderboard (Lo & Hew, 2020). In future practice, teachers can consider presenting this kind of elements as an award to encourage their access to the online resources for their test/exam preparation (e.g., students will receive a “hard working” badge) and their good performance in the tests (e.g., students will receive digital points to be shown in a leaderboard).

5.3 Students’ Mixed Feelings Toward Game-Based Learning

The findings of student interviews suggested that student perceptions of our game-based learning activities were mixed. These basically resonated with the findings of Hung et al. (2019). The researchers reported that some students regarded the use of these activities as a waste of time, but others found it engaging. Under the constraint of the reduced class time during the pandemic, teachers have to pay particular attention to the time allocation of each in-class activity. As Webel et al. (2018) commented, spending about 10 min (out of 40 min per lesson) on the Kahoot! quizzes might be a negative example of how the flipped lessons were structured. Based on what we have learned from our intervention, we recommend using the game-based learning activities occasionally (e.g., every 2–3 lessons) within 10 min. Therefore, teachers should select the most essential questions to assess student learning and provide feedback on student performance accordingly. Other questions can be done remotely as a pre-class learning activity.

To recall, we used the game-based learning activities to boost interactions inside the classroom, where the students sat far apart (at least 1.5 m) from each other. Besides game-based learning, another possible strategy is the use of online co-editing application, such as Google Docs and Google Slides for interactive learning activities. For example, Google Slides is an online presentation application that allows several students to synchronously draw on a shared slide (Wang & Huang, 2016), which enables students’ collaborative mathematics constructions. Teachers can thus create a web-based co-authoring environment inside the classroom. Using their own device, students can discuss and share their work via online documents without the need of physically sitting in a group.

5.4 Limitations and Recommendations for Future Research

Although this study has contributed to the literature by laying the groundwork for informing future flipped classroom practice (i.e., the use of game-design elements and game-based learning activities) and research (i.e., large-scale interventions with a longer duration), several limitations are worth noting and necessitate further research. First, the duration of our intervention was short (2 weeks). A novelty effect might have influenced student achievement and perceptions because the flipped classroom

approach and game-based activities might be new to our students. If the pandemic continues, empirical studies with a longer duration (e.g., 1 semester) are recommended to examine the actual effects of this instructional environment in this very trying time.

Second, our study involved only 20 students. One should exercise caution when interpreting our research findings because the generalizability is limited due to the small sample size. Future studies can involve multiple classes from different schools. Researchers can thus compare and synthesize the views and experiences of different teachers and students. Besides, the design and implementation of fully online flipped classrooms can be evolved through design-based research in which multiple interventions are iteratively conducted. The design framework of the flipped classroom approach can thus be refined and improved based on the empirical findings in each iteration (see Lo & Hew, 2021a for a review).

Third, our study was conducted in a secondary school mathematics classroom. Therefore, our research findings and recommendations may be context-specific. We suggest further research be conducted in other contexts (e.g., primary schools, science education, and language education). This will improve our understanding of how to use the flipped classroom approach during the pandemic in various educational settings.

6 Conclusion

During the COVID-19 pandemic, schools in many parts of the world had to reduce their face-to-face class time. Therefore, teachers should seek for an approach to enabling an effective use of class time. In this study, we testified the use of the flipped classroom approach in a secondary school mathematics classroom. Besides, Kahoot! quizzes were used to facilitate interactions inside the classroom. After our 2-week intervention, students' mathematics achievement increased, and this increase could sustain over 2 weeks. The results suggested that the flipped classroom approach could be a desirable pedagogy to be used during the pandemic. However, our students had mixed feelings (i.e., engaging vs. a waste of time) toward the game-based learning activities. In future practice, teachers should select the most essential questions for the activities. Furthermore, teachers can consider using online co-editing application (e.g., Google Slides) which enables students' web-based collaborative mathematics constructions under the constraint of social distancing.

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Exploring the Relationships Between Online Learning, Motivation, Social Presence, and Learning Efficacy



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Abstract Online learning emerges as an alternative mode for students to learn remotely in response to the shutdown of campus during COVID-19 pandemic. However, students who learned online usually had higher dropout rates and easily distracted from learning. This study aimed to examine the determinants that affect students' learning motivation in online learning. The research question is: What are the factors affecting students' motivation to learn in online learning? It was hypothesized that preference to online learning, social presence like engaging or interacting with peers and teachers, and learning efficacy influenced students' learning motivation. A survey was distributed to 100 Hong Kong undergraduates. The result showed that preference to online learning had a direct, positive, and significant effect to learning motivation ($\beta = 0.295, p < 0.001$). Moreover, learning efficacy demonstrated a significant interaction effect with preference to online learning to increase learning motivation ($\beta = 0.223, p < 0.05$), while social presence demonstrated a significant interaction effect to decline learning motivation ($\beta = -0.270, p < 0.01$). The findings suggested that learning efficacy and social presence play different roles on motivation in online learning, respectively. The implications were discussed.

Keywords Online learning · Motivation · Social Presence · Efficacy

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1 Introduction

The COVID-19 pandemic has brought sudden shutdown of campus, shifting the on-campus learning to online learning that involves virtual courses and distance education offered over the internet. Online learning began from mid-1990s because of the rapid development of World-Wide Web and become popularized recently for its promising benefit to avoid infection due to face-to-face interactions in campuses during pandemic. Online learning is also characterized by its convenience and flexibility in achieving learning outcomes compared to traditional education. Online learning is not restricted by time and space so learners can enjoy higher flexibility in adjusting or scheduling their own learning progress. However, students were found with higher dropout rates and lessened attention when they were participating in online learning (Xu & Jaggars, 2013). Students may lose learning motivation if they continue studying in online learning environment.

It is possible for online learning to continue developing as one of the mainstream learning modes in the future, but it leaves concern whether students' learning motivation would be impacted. The objective of this study, therefore, is to explore factors that influence learning motivation in the online learning environment. Research questions of this study is as follow: What are the potential determinants that affected online learning motivation?

The rest of this paper first includes a literature review describing previous research on online learning motivation and identifying the factors that influenced the motivation. After that, it includes the methodology illustrating the study background, subjects, measurement instrument and data collection. Finally, it includes the result of data analysis and implications that might be suggested.

2 Literature Review and Hypotheses Development

2.1 *Preference to Online Learning*

Although online learning emerges as an alternative learning mode that compensates face-to-face teaching under the shutdown of on-campus education, it may be perceived by learners as a better way for achieving learning goals. Students' preference to online learning being the better learning method, is an important determinant that affects students' online learning endeavor. Online learning is an instruction delivered on a digital device (such as a desktop computer, a laptop computer, a tablet, or a smartphone) that supports learning (Clark & Mayer, 2011). Online learning can be perceived as a newly emerged learning system whose primary purpose is technological-driven and education-focused (Aldiab et al., 2017). Lesmes-Anel et al. (2001) defined preference to online learning as one form of learner preference, which refers to an individual strength of preference in learning behaviors that facilitates

learning process. Preference to online learning is an individual strength of preference in using digital devices or utilizing technology to achieve education-focused tasks.

2.2 Learning Motivation

Motivation to learn is characterized by long-term, quality involvement in learning and commitment to the process of learning (Ames, 1990). Past studies have found that higher learning motivation encouraged higher preference to online learning (Beard-sley et al., 2020; Keskin & Yurdugül, 2020; Li & Tsai, 2017). Learners who prefer online learning are more likely to spend time in the online environment. For example, they are more committed to achieve learning outcomes like attending online courses punctually or more willing to accomplish challenging learning tasks like homework and quizzes (Akcaoglu et al., 2018; Joo et al., 2012; Wang et al., 2013). They are usually highly motivated because their commitment to online learning promotes their learning competence and satisfaction (Baturay & Yükseltürk, 2015; Cull et al., 2010). In the long run, learners who have higher preference to online learning will have higher learning motivation that continues to be sustaining (Yurdugül & Demir, 2017).

Learner's motivation plays a very crucial role in achieving learning outcomes (Selim, 2007). Motivation boosts self-regulatory behaviors in online learning, which promotes students' better execution of metacognitive strategies to avoid being distracted but permits retaining attention in online learning (Cho & Kim, 2013). Empirical studies found that highly motivated E-learners often had higher online participation, better learning performance and stronger tendency to mastery-oriented learning behaviors (Barba et al., 2016; Giesbers et al., 2013). Therefore, it was hypothesized that:

H1: Higher preference to online learning was significantly related to higher learning motivation of students.

2.3 Social Presence

Social presence is an ability to perceive, interact and communicate with others in different medium. Students may have low level of social presence in some medium such as text-based communication and online communication (Short et al., 1976). Students are expected to perceive and experience different extent of social presence depending on different learning contexts such as face-to-face education and the online learning environment. Social presence, however, influences students' learning performance by influencing their learning motivation (Tu & McIsaac, 2002). Social presence is closely related to instructor-learner and learner-learner interactions, which facilitates vivid discussion and exchange of constructive feedbacks (Alsadoon, 2018;

Tu & McIsaac, 2002). Under social interactions, students were found more excited to learn and motivated to share useful materials with peers (Reio & Crim, 2013). Hitlz (1994) also mentioned that social interaction was the most “natural way” for students to learn. Students’ participation was encouraged through constructive interaction with instructors and classmates, and enjoyment in learning was boosted (Hostetter, 2013). Past studies suggested that courses with social interaction elements considered like group discussion promoted higher course and instructor satisfaction, which guaranteed students’ better motivation to learn (Garrison & Akyol, 2013; Mykota & Duncan, 2007).

Online learning may create potential barriers to social interaction between learners because it inserts a layer of mediation between those involved in the course (Johnson, 2011). Learners can only learn via internet while they have less exposure to face-to-face interaction with other learners and the instructor. Due to the lack of social presence in online learning environment, students may be less motivated to learn. However, students who perceive online learning as their style to learn may not have their learning motivation declined in online learning because they can learn individually at their preferred time and complete home-based assignment that suits their needs better (Tayebinik & Puteh, 2012). Social presence, which encourages social interactions, however, may hinder students’ flexibility to learn at their own preference. They are required to participate in specific group discussions or assigned of tasks by instructors, which hinder their learning progress. Social presence serves as a barrier for students who have strong preference to online learning. It was argued that students who have strong preference to online learning may not have high motivation to learn if they are encouraged to engage social interactions in class. Therefore, it hypothesized that:

H2: Preference to online learning demonstrates a significant interaction effect with social presence to decrease learning motivation.

2.4 *Learning Efficacy*

Learner efficacy refers to the beliefs in one’s capabilities to be successful in a particular learning task or course in the process of learning (Bandura, 1997, p. 3; Tilfarlioglu & Ciftci, 2011). Learning efficacy motivates students to achieve learning goals by increasing their learning interests and engagement in learning (Schunk & Pajares, 2002; Zimmerman, 2000). Learners who have higher learning efficacy are more likely to achieve more challenging tasks like attending difficult courses (Latip et al., 2020). Self-efficacy thrusts students into a feedback loop which impacts their learning performance in a positive way (Marshman et al., 2018). Students who have higher learning efficacy usually are more motivated to learn (Pintrich, 2003; Zimmerman, 2000).

Learning efficacy is an important determinant in students’ online learning endeavor. Learning efficacy builds a bridge of connecting online learning acceptance and online learning motivation (Laptip et al., 2020). In the online learning context,

students having higher learning efficacy usually have higher perception of the benefits of using technology in learning (Lwoga & Komba, 2015). Moreover, students who have higher learning efficacy in online learning experience will have higher competence and interest to learn. Online learning significantly provokes learners' interest in learning, which enhances their learning efficacy (Lim et al., 2020). Thus, we argued that learning efficacy would add additional motivation to those who preferred more to online learning as their mode of learning. Therefore, this study hypothesized that:

H3: Preference to online learning demonstrates a significant interaction effect with learning efficacy to increase learning motivation.

3 Methodology

3.1 Subjects

An online survey instrument was distributed to 103 undergraduates and was received from 100 respondents who completed the whole survey. The respondents ranged from 18 to 52 years of age ($\text{Median}_{\text{age}} = 21$; $\text{IQR}_{\text{age}} = 6.5$), including 1 mature student who aged 52 years old. This sample was chosen because they were undergraduates who had experienced the swap from conventional face-to-face learning to online learning during pandemic.

3.2 Measurement Items

The participants were first asked to provide their demographic data including their gender and age. After that, they were asked to respond to items that assessed their level of preference to online learning, learning motivation, social presence, and learning efficacy, respectively. The Attitude Questionnaire Regarding the E-lecture Experience was adopted to measure students' preference to online learning. The scale contained 20 items which measured students' attitudes toward online learning (e.g., I considered the digitalized lecture that I viewed as a positive learning experience; I think that viewing an e-lecture at home as many times as I wish gives me the opportunity to better reflect on the content of the lecture) and the scale was previously validated (Demetriadis & Pombortsis, 2007). Participants were asked to rate each item on a five-point Likert scale (1 = "Strongly Disagree" to 5 = "Strongly Agree"). Scale for Learning Motivation was adopted to measure students' learning motivation. The scale contained 24 items which measured their motivation to learn (e.g., I think I am learning in this class that is useful for me to know; Compared to other courses, I am more attentive in this course) and it was previously validated (Yang & Cai, 1999). Respondents rated each item on a 5-point Likert scale (1 = "Not all True" to 5 = "Very True to Me"). To measure their level of social presence,

Scale for Social Presence was adopted. The scale contained 10 items that quantified their ability to perceive social presence in class (e.g., I was able to form distinct individual impressions of some course participants; I felt comfortable participating in course discussions) and it was previously validated (Richardson & Swan, 2003). Respondents rated each item on a 6-point Likert scale (1 = “Strongly Disagree” to 6 = “Strongly Agree”). Finally, respondents’ learning efficacy was measured by the Scale Learner Readiness for online Learning. It contained 18 items that assessed their online learning efficacy (e.g., I feel confident in performing the basic functions of Microsoft Office programs (MS Word, MS Excel, and MS PowerPoint; I can direct my own learning progress) and it was validated previously (Huang et al., 2010). Respondents were required to rate each item on a 5-point Likert Scale (1 = “Strongly Disagree” to 5 = “Strongly Agree”).

3.3 Data Collection

The questionnaire was set and distributed to the subjects via the Qualtrics survey platform. Invitation links were sent to students through researchers’ personal network twice. Participants were first required to respond and complete the questionnaire at the beginning of the E-lecture. The respondents were college students at a higher education institution in Hong Kong.

4 Findings

4.1 Descriptive Statistics of Respondents and Variables

Most of the respondents have above-average level of preference to online learning (26.5/35; 75.7%). The descriptive statistics of the psychometric variables were shown in the table below. The Cronbach’s alpha of each scale all scored 0.85 or above, indicating a good measurement reliability (Table 1).

Table 1 Descriptive statistics of scale items

	<i>M</i>	<i>SD</i>	Alpha
Learning motivation	96.4	12.4	0.959
Social presence	22.5	3.83	0.934
Learning efficacy	23.8	3.66	0.856
Preference to E-learn	26.5	5.78	0.886

Predicted Dependent Variable: Learning Motivation

4.2 Summary of Moderation Analysis

To examine the direct effects of the studied predictors (Preference to Online Learning, Social Preference and Learning Efficacy), as well as the interaction effects between the predictors (preference to online learning \times social preference and preference to online learning \times learning efficacy) on learning motivation, linear regression is adopted to test the model.

All variables have been standardized before conducting multiple regression analysis. The two interaction terms were computed by multiplying the standardized score of preference to online learning with the standardized score of social presence and the standardized score of learning efficacy, respectively. The standardized score of preference to online learning and the two interaction terms were considered as the explanatory variables which predicted the standardized value of learning motivation.

Since there were no indirect effects involved in the model, the use of linear regression is more appropriate and sufficient than path analysis for the model testing. The model treating learning motivation as dependent variable was significant ($R^2 = 0.607$, $p < 0.001$), implying the model significantly explained 60.7% variance of learning motivation (Refer to Table 2).

For the path coefficients, preference to online learning significantly predicted a higher level of motivation ($\beta = 0.295$, $p < 0.001$), implying for every standardized unit of preference to online learning increased, there would be 0.295 standardized unit of learning motivation increased. The result supported H1.

Moreover, social presence significantly predicted higher level of learning motivation ($\beta = 0.296$, $p < 0.001$), implying for every standardized unit of social presence increased, there would be 0.296 standardized unit of learning motivation increased. In addition, learning efficacy significantly predicted a higher level of learning motivation ($\beta = 0.415$, $p < 0.001$), implying for every standardized unit of social presence increased, there would be 0.415 standardized unit of learning motivation increased.

Regarding the interaction analyses, preference to online learning demonstrated a significant interaction effect with social presence on learning motivation ($\beta = -0.309$, $p < 0.001$), implying for every standardized unit of the interaction term increased, there would be 0.309 standardized unit of learning motivation decreased. The above results supported H2. Finally, online learning demonstrated a significant interaction effect with learning efficacy on learning motivation ($\beta = 0.223$, $p < 0.05$), implying for every standardized unit of the interaction term increased, there would be 0.223 standardized unit of learning motivation increased. These results supported H3 (Refer to Table 3).

Table 2 Linear regression model testing results

	Model summary				ANOVA	
	<i>R</i>	<i>R</i> ²	Adjusted <i>R</i> ²	SE of estimate	<i>F</i>	Sig
Learning motivation	0.779	0.607	0.586	0.647	28.7	0.000

Table 3 Summary of path coefficients

Factor	Unstandardized coefficients		Standardized coefficients	<i>t</i>	<i>p</i>
	<i>b</i>	SE	β		
Preference to online learning	0.297	0.072	0.295	4.14	0.000
Social presence	0.297	0.106	0.296	2.80	0.006
Learning efficacy	0.417	0.107	0.415	3.91	0.000
Preference to online learning \times social presence	-0.270	0.09	-0.309	-3.04	0.003
Preference to online learning \times learning efficacy	0.203	0.09	0.223	2.19	0.031

ModGraph was used to display the moderation effects of social presence and learning efficacy on the association between preference to online learning and learning motivation, respectively (Jose, 2008). To explore the moderation effect of social presence, the score of preference to online learning and social presence were categorized into three groups. High-scoring group contained scoring above 1 standard deviation of the mean; the medium-scoring group included scoring within 1 standard deviation of the mean; the low-scoring group consisted of scoring below 1 standard deviation of the mean (Aiken & West, 1991). Figure 1 shows that social presence moderated the association between preference to online learning and learning motivation. When students preferred online learning least, those with higher scores on social presence were more motivated than those with lower scores. The difference was lessened when preference to online learning was increasing from low to high levels.

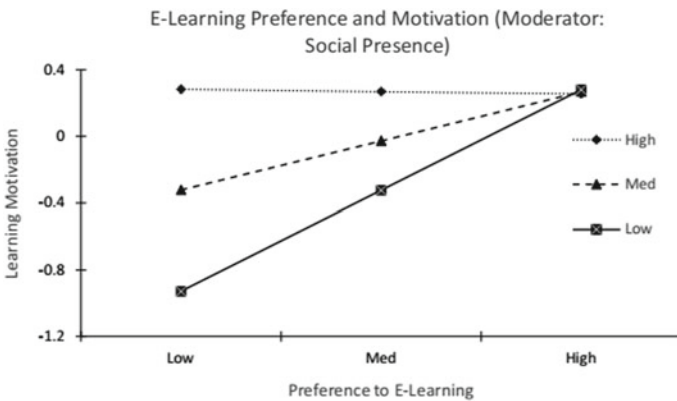


Fig. 1 Social presence as a moderator for preference to online learning and learning motivation

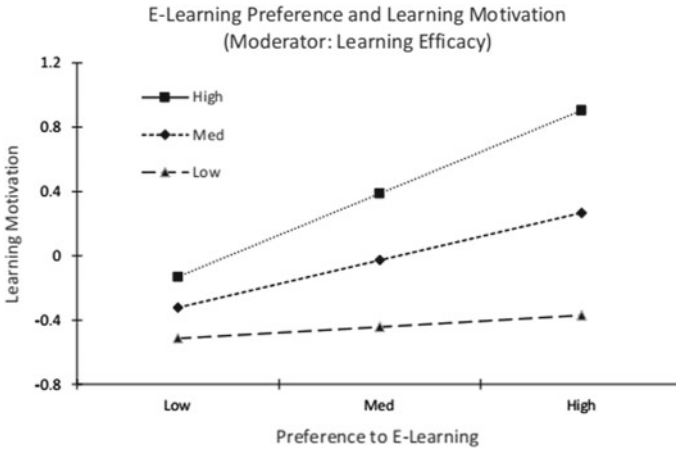


Fig. 2 Learning efficacy as a moderator for preference to online learning and learning motivation

Regarding the moderation effect of learning efficacy, the score of preference to online learning and learning efficacy were categorized into three groups in the similar way as above. The high-scoring group contained those scoring above 1 standard deviation of the mean; the medium-scoring group included those scoring within 1 standard deviation of the mean; and the low-scoring group consisted of those scoring below 1 standard deviation of the mean (Aiken & West, 1991). Figure 2 shows that learning efficacy moderated the relationship between preference to online learning and learning motivation. However, learning efficacy demonstrated a different moderation effect than what social presence performed. For students who least preferred to online learning, those with higher scores on learning efficacy were more motivated than those with lower scores. The difference in learning motivation was broadened when preference to online learning was increasing from low to high levels.

5 Discussion

The study aims to examine which factors might have impact on learning motivation during online learning experience. Specifically, it aimed to explore (1) whether preference to online learning predicted higher learning motivation, and (2) identify potential determinants that influenced online learning preference and learning motivation.

5.1 Online Learning Preference, and Motivation

In this study, most of the respondents had an above-average level of preference to online learning (26.5 out of 35; 75.7%). The finding demonstrated that preference to online learning significantly predicted higher learning motivation. The result was consistent to our hypothesis that learners having higher preference to online learning being their individual learning style would tend to have higher learning motivation.

5.2 Online Learning Preference, Social Presence, and Motivation

Consistent with our second hypothesis, preference to online learning demonstrated a significant interaction effect with social presence to decline learning motivation. The finding implies that learners who preferred online learning as their learning style will have lower learning motivation if they perceive higher level of social presence in the learning environment. Different from previous research that showed social presence as an important factor to increase learning motivation, the current study further confirms the moderating role of social presence in online learning activities. Those who preferred online learning as their style of learning may not favor social interactions in class and their learning motivation will be declining if they are required to be involved in social interactions.

5.3 Online Learning Preference, Learning Efficacy, and Motivation

Consistent with our last hypothesis, preference to online learning demonstrated a significant interaction effect with learning efficacy to increase learners' motivation. The finding implies that students who preferred online learning as style of learning will have higher motivation to learn under the condition that they have high learning efficacy. Given if the online learning mode is adopted, teachers or course designers are essential to enhance students' learning efficacy for the sake of better learning motivation.

5.4 Limitations

However, the current study has several limitations. First, it is a cross-sectional study, which can only inform potential casual relationships but not exact or intervention effects of social presence and learning efficacy to learning motivation. Moreover,

the current study included responses of the students coming from only one institute, diminishing its generalizability to other populations. Future study is required to explore and compensate those limitations.

6 Conclusion

This study confirms the importance of preference to online learning as a learning mode to enhance learning motivation. Online learning can be considered as an effective learning mode for students given that learners have high preference to learn online or through another technological-based medium. This study has found that students who preferred online learning experience will have their learning motivation improved by enhancing their learning efficacy instead of creating social presence like interaction discussion with peers. Practitioners or teachers who would adopt online learning in their teaching and course design in the future should consider enhancing students' learning efficacy if they want to increase students' learning motivation.

For learners who preferred less to online learning, practitioners should consider introducing components of social presence in their teaching, including initiating discussion among students, or assigning group work that requires their cooperation. Yet, practitioners are still encouraged to enhance learner's learning efficacy which is perceived as the most essential factor that boosts their learning motivation.

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A Review on Blended Learning for English Language Teaching in Indonesian Higher Education



Putri Gayatri, Shen Chen, and Helena Sit

Abstract Blended learning as part of internet-based teaching has increasingly been used due to the covid-19 pandemic. Numerous studies have demonstrated how blended learning should be implemented in diverse contexts, including in the teaching of English as a second or foreign language (ESL/EFL). However, in the Indonesian higher education context, blended learning is considered a new approach. As this concept has been defined variously, many university teachers in Indonesia find it challenging to understand the concept and implement this approach. Addressing such an issue, this paper aims to provide an understanding of blended learning and how this pedagogical approach fits EFL teaching in the Indonesian higher education context. Qualitative secondary research and document review were conducted to explore the various definitions of blended learning and obtain an understanding of the approach. Studies on blended learning models or pedagogical strategies conducted in America, Europe, and Asia and the implications of those models in English language teaching are discussed. Furthermore, how culturally appropriate blended pedagogical practices/recommendations are for EFL teaching in Indonesia was also scrutinised to address the current research gap.

Keywords Online learning · Blended learning · Internet-based teaching · Learning environment and design · Pedagogical approach

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1 Introduction

The covid-19 pandemic has radically transformed the education sector. Since people around the globe are encouraged to isolate themselves to minimise the spread of the virus, information and communication technology (ICT) in higher education becomes essential, including in English as a second or foreign language (ESL/EFL) teaching. The ESL/EFL teaching which was previously conducted in face-to-face mode must move to the online environment by using the internet. Consequently, many teachers and students find it challenging to deal with such a virtual teaching and learning process, especially if they are not familiar with internet-based teaching and learning.

In Indonesia, education has been facing many challenges during the pandemic. Since most teachers and students are only familiar with the traditional teaching in the classroom and have minimal experience in implementing e-learning, as vastly reported by the media, the Indonesian educational system then runs as “trial and error” (Aji, 2020). For example, Arifa (2020) explained that in less than a month since the first application of e-learning in Indonesia, the Child Protection Commission has received 213 complaints, reporting bulk assignments as irritating learning experiences for students. Further, she described that in one of the reputable universities in Indonesia, only 66.9% of students comprehend the materials during online learning due to teachers’ inability to manage the online class effectively. Therefore, not only teachers and students but also parents/carers expect that the teaching and learning process can be conducted in the physical classroom environment again.

1.1 *Blended Learning Proposal*

Currently, as the covid-19 vaccination has started, the Indonesian Ministry of Education is looking at the possibility of combining online interactions with traditional face-to-face teaching in the classroom, known as blended learning (Bielousova, 2017; Lungu, 2013; Norberg et al., 2011; Staker & Horn, 2012). This upcoming policy is not only triggered by the fact that both the teachers and students want to return to school, but also by the government’s awareness of the advantages of internet-based teaching during the pandemic, especially for ESL/EFL teaching. Furthermore, as much research outside Indonesia has reported, blended learning can improve students’ four English skills—listening, speaking, reading, and writing (Banditvilai, 2016), promote autonomous learning (Busaya & Saovapa, 2018), and provide opportunities for students to do self-evaluation without pressure (González & Álvarez, 2007). Based on the rationale, the Indonesian Ministry of Education instructed the implementation of blended learning in the higher education setting, starting from January 2021 (Circular Letter of Learning Organisation in Higher Education, 2020;

Circular Letter of Learning Organisation in Vocational Education, 2020) and encouraged blended learning to be permanently implemented in Indonesia once the covid-19 pandemic is over (Maharani, 2020).

The government's policy seems to be promising to the development of English language teaching in Indonesia. However, teachers and students in Indonesia are not familiar with blended learning (Wuryaningsih et al., 2019). Although the design of distance education has been discussed and encouraged in Indonesia since 1950 (Zuhairi et al., 2006), combining distance education and classroom interaction is not an easy task. It requires depth studies. Besides, distance education developed in Indonesia does not require the internet as the primary source of learning. The decree of The Ministry of Education (number 107/U/2001) about distance education states that printed materials for self-study should be available, accompanied by any other media (Indonesian Minister of Education Decree, 2001). Hence, the state distance university, Indonesia Open University, still uses printed materials as the primary source of distance learning instead of multimodality (Darajat, 2016; Husain, 2020).

In Indonesia, limited equipment and internet access have been reported as fundamental boundaries of internet-based teaching (Muslem et al., 2018). Internet adoption for education in Indonesia is still being developed (Zen, 2019), and some districts are not ready for internet-based learning (Arifa, 2020). In addition, most Indonesian teachers' ICT proficiency is low (Muslem et al., 2018) and they lack the ability to prepare online instruction (Sari et al., 2020). However, technology is developing. Currently, the Indonesian government focuses on encouraging the use of educational technology (Amri et al., 2019). Also, the government requires Indonesian universities to provide online learning like other universities in the world (Zen, 2019).

This reality suggests that online learning is not yet prevalent in Indonesia, so that merging online and classroom interactions becomes a big challenge, especially when people's knowledge of it is limited. In Indonesian universities, EFL teachers' interpretation and implementation of blended learning are still problematic. They may have their own interpretation of the blended learning concept, let alone consider how to implement it in EFL teaching and learning due to the lack of an explicit teacher training model (see Andrini et al., 2020; Lactona & Suryanto, 2021; Oktavianto et al., 2021; Mustadi et al., 2021).

In short, the government has proposed the implementation of blended learning in Indonesia and encouraged blended learning considered as a new pedagogical approach to embed in course design and development, including in English language education programs. However, how teachers should apply this approach in their teaching and learning processes is still not clear. The government has not provided a blended learning model for ESL/EFL teaching which guides teachers in using the approach. In other words, there is a pedagogical problem that remains overlooked in the government's planning.

Research on the blended learning model, especially for EFL teaching in Indonesia, is still scarce. Although there is a high demand from the government to employ this approach, the interpretation of the blended learning concept is still different. For example, in the context of blended learning implementation during the covid-19 pandemic in Indonesia, the EBSCO database recorded four peer-reviewed

journal articles using different definitions of blended learning. Blended learning is defined as the combination of asynchronous online learning and synchronous online webinar/synchronous face-to-face online interactions (see Andrini et al., 2020; Lactona & Suryanto, 2021); the combination of online interactions and hands-on learning in which the students individually observe the learning object in the field (see Oktavianto et al., 2021); and the mixture of various synchronous and asynchronous online learning experiences, including learning through social media, university platform, zoom application, and google classroom (see Mustadi et al., 2021).

Consequently, to fill the gap, a study that focuses on blended learning pedagogy is urgently required. It is crucial now to clarify what blended learning is and develop a precise model or contextualised pedagogical strategies of blended learning that will form meaningful EFL teaching and learning in the Indonesian higher education context. Since the Indonesian government has already instructed the use of blended learning while many Indonesian teachers' knowledge is limited, it is essential to examine the existing effective models of blended learning from the global context and discuss the feasibility of model adoption/adaptation/modification in the Indonesian higher education setting. Furthermore, the researchers could probe whether the researchers can integrate the advantages of each existing model to develop a new model based on the socio-cultural context of Indonesia. Therefore, this paper aims to clarify what blended learning is and how this pedagogical approach fits the EFL teaching in the Indonesian higher education context. It is anticipated to scrutinise culturally appropriate blended pedagogical practices/recommendations for EFL teaching in Indonesia to address the current research gap.

2 Methodology

In this study, qualitative secondary research and document review were conducted to achieve the objective of the research. Largan and Morris (2019) explain that qualitative secondary research is "a systematic approach to the use of existing data to provide ways of understanding that may be additional to or different from the data's original purpose" (p. 14). Even though Indonesian teachers have different interpretations of blended learning, this approach is not a new pedagogical concept in other countries, especially in western countries. Thus, the researchers decided to examine the existing literature related to the history and concept of blended learning to better understand the approach in the global context. In addition, the researchers reviewed the Indonesian government's documents related to the regulation of blended learning implementation to assure the conformity of the global concept and the demand from the Indonesian government.

Furthermore, since blended learning is considered a new approach that even its interpretation is still problematic in Indonesia, the researchers investigated a wide range of studies on successful blended learning models from abroad. The researchers focused on research reporting the practices of the blended learning model in English

language teaching in higher education settings. This review is beneficial to capture the best model of blended learning for EFL teaching in Indonesian higher education. In doing so, the researchers applied the data collection process suggested by Largan and Morris (2019), which included the data search process, selection process, and reduction process (if necessary) before then analysing the data.

2.1 Criteria for Data Search Process

To understand the concept of blended learning and probe how this approach should be implemented in EFL teaching, the researchers included all relevant books, journal articles, and research reports, including conceptual papers and experimental research articles. Also, the Indonesian government's documents related to the policy of blended learning implementation during the covid-19 pandemic were accessed. To comprehend the concept of blended learning in the global context, the researchers examined relevant articles from various countries related to the history and the concept of blended learning since 2000. The researchers decided to use the year 2000 as the selection criteria because blended learning starts to be one of the pedagogical approaches in the early of that year (Güzer & Caner, 2014). Furthermore, the keywords of "history of blended learning" and "definition of blended learning" were used to search the data.

On the other hand, to explore the model of blended learning, the researchers focused on journal articles and research reports in the past ten years to confirm its update. However, as the researchers found that the updated research adopted or adapted the precursor model, the researchers referred to the original document of the model even though it was developed more than ten years ago. The researchers used the keyword "blended learning model" or "blended learning practice" with "English", "English language", and "English teaching" to gather the data related to how blended learning was implemented in English language teaching. In addition, even though there was no specific geographical location required, all the journal articles should be written in English, and the full text should be available.

2.2 Selection Procedure for Collection of the Literature

Since there is a large number of data available online, to reassure the quality of the selected data, the researchers applied a database-based searching strategy. The researchers used the EBSCO Host database because it is a specific education database accessible for the researchers and it provides peer-reviewed journal articles. To address the first aim of the study, the researchers first searched for a handbook of blended learning by looking at review articles of the handbook from the database. There were two handbooks of blended learning that were reviewed in the database. Then, the researchers accessed the printed or electronic version of the book. The

reason for reviewing the handbook was that it was one of the definitive sources to comprehend blended learning. Besides, the researchers searched the relevant peer-reviewed journal articles from the EBSCO Host database by implementing some limiters mentioned in the selection criteria. After all, the researcher visited the official website of the Indonesian Ministry of Education and Culture to access the latest government documents related to the policy of blended learning application in the Indonesian higher education context. There were two recent regulations related to the instruction of employing blended learning in the higher education context.

To accommodate the second and third aim of the study, the researchers used the same database to search the peer-reviewed articles, research reports, and book chapters related to the model or pedagogical strategies of blended learning in English language teaching in the last 10 years.

2.3 Criteria for Inclusion and Exclusion

In the initial data searching process, 2 handbooks, 37 peer-reviewed journal articles, and 2 government documents to address the first aim of the study were obtained. Thus, in total, there were 41 data sources available. The obtained data were then initially reviewed by doing skimming and scanning to probe the relevancy of the information in the data with the aim of the research. The following questions guided the decision to include or exclude the data:

- a. Does the article present a detailed explanation of the blended learning concept or propose a new idea towards the approach?
- b. Is there any justification for the concept the author presents?

After the initial review, all the handbooks and government documents were considered relevant to address the aim of the research. However, only 11 out of 37 articles were considered relevant to be analysed further to address the first aim of the study due to duplication and relevancy of the content. From these 11 articles, the researchers found important information that was dug up and let the researchers include 3 more articles as the extended data. In total, there were 18 data sources to be analysed with respect to the first aim of the research, as presented in the following Table 1.

For the second and third aims of the study, 47 peer-reviewed journal articles matching the keywords were found. The researcher then conducted the initial review by focusing on these questions:

- a. Does the article provide a description or explanation of the model?
- b. Does the article explain the procedure or steps in organising the approach?
- c. Does the article provide the result of the implementation?

Besides its relevancy, the researcher used other criteria to include or exclude the data. First, the blended learning concept on the paper should be in line with the result of the discussion on the blended learning concept presented in this paper. Any articles on blended learning which define blended learning differently were not included in

Table 1 Documents related to the concept of blended learning

Types of data	Findings
Handbook	Bonk and Graham (Eds.) (2006) Ferdig and Kennedy (Eds.) (2014)
Journal articles	Cronje (2020) Hrastinski (2019) Fanguy and Costley (2021) Kleber (2015) Alammary et al. (2014) Saichaie (2020) Singleton (2013) Picciano (2009) Helms (2014) Hughes (2008) Sharma (2010) Whitlock and Jelfs (2003) Cooney et al. (2000) Allen et al. (2007)
Government documents	Circular Letter of Learning Organisation in Higher Education (2020) Circular Letter of Learning Organisation in Vocational Education (2020)

this study. Second, the context of the research should be the implementation of blended learning for English language teaching in higher education context or adult learners only. Third, the research design should be experimental, either qualitative, quantitative, or mixed-method. By examining the experimental research on how blended learning is implemented, the researchers could see the strengths and the weaknesses of the model, which could not be seen by looking at the conceptual paper. As a result of this inclusion and exclusion criteria, including deleting the duplicated articles, 30 articles were eliminated, resulting in 17 articles left to be analysed. Moreover, examining these 17 articles, the researchers were then directed to search and examine 5 more data sources related to the model of blended learning. Thus, 22 articles were analysed, as shown in Table 2.

In total, the researchers collected 40 various data sources related to the concept and implementation of blended learning in English language teaching. The researchers analysed and synthesised the data before reporting the results qualitatively. The exploration of blended learning practices was used to propose the blended learning model for EFL teaching in Indonesian higher education.

3 Defining Blended Learning

Before encouraging Indonesian educators, including EFL teachers, to implement blended learning, the concept should be defined clearly and understood. Otherwise, each teacher may have different interpretation about what to blend and how to

Table 2 Search result of data related to blended learning models in English teaching

Types of data	Finding	Theme
Research reports	Staker (2011) Staker and Horn (2012)	American model development
Book chapter	Jaques and Salmon (2006)	European model development
Journal articles	Salmon et al. (2010) Isakova et al. (2020) Farooq and Mahmood (2014) Chunyi (2018) Yaroslavova et al. (2020) Paliwoda-Pekosz and Stal (2015) Mehring (2018) Kraft et al. (2013) Buitrago and Díaz (2018) Wagner-Loera (2018) Leis (2018) Turan and Akdag-Cimen (2019) Busaya and Saovapa (2018) Nanclares and Rodríguez (2016) Sung (2015) Valiathan (2002) Kvashnina and Martynko (2016) Kadambaevna et al. (2021) Janković and Spasić (2014)	European model development European model adaptation European model adaptation Local model implementation American model adaptation Local model implementation (Poland) American model adaptation Asian model adaptation American model adaptation American model adaptation American model adaptation American model adaptation American model adaptation American model adaptation American model adaptation Asian model development American model adaptation Local model implementation

blend, which may cause ineffective EFL teaching. In some cases, blended learning is also called mixed-mode learning, hybrid instruction/learning, combined learning, or technology-mediated enhanced learning (Moskal et al., 2013; Wang et al., 2015). This approach does not only have various interchangeably terms but also have various interpretations. Oliver and Trigwell (2005) argue that while the concept has been recognised, there is no clear picture about what to be blended. It can refer to the blending of e-learning and traditional learning, the blending of online and face-to-face learning, blending the media, blending the contexts, blending the learning theories, as well as blending the pedagogies. Therefore, as recent literature shows that blended learning has many definitions (Yu, 2015), it is essential to clarify its concept by reviewing the documents and research articles related to blended learning to gain the experts' conceptual understanding of this approach.

From the 18 data sources the researchers obtained, it was found that the majority of the scholars perceive blended learning as the combination of face-to-face and online interactions (e.g., Alammary et al., 2014; Allen et al., 2007; Fanguy & Costley, 2021; Ferdig & Kennedy, 2014; Helms, 2014; Hrastinski, 2019; Hughes, 2008; Kleber, 2015; Picciano, 2009; Saichaie, 2020; Singleton, 2013). However, they were slightly different in employing the framework for their definitions. For example, Kleber (2015) and Alammary et al. (2014) emphasise that blended learning should be more than blending two learning modes. It should also comprise students' control

over path/pace, especially during online interactions. Thus, according to them, integrating web-based teaching in which the students are still fully controlled by the teacher during interactions cannot be classified as blended learning. More accurately, Hughes (2008) lists six considerations in defining blended learning, including whether the integration promotes the construction of knowledge, is based on the constructivist theoretical framework, explores the technology which accommodates student-centred learning, uses a broad range of media sources, transforms the role of learners and teachers, and is considered more effective than fully online or face-to-face teaching only.

While scholars such as Alammary et al. (2014), Fanguy and Costley (2021), and Ferdig and Kennedy (2014) define blended learning as the mixing of online and face-to-face interactions, Hrastinski (2019) and Sharma (2010) accept other interpretations of blended learning while holding that definition. They believe that in addition to the common interpretation, blended learning can also be comprehended as the combination of various instructional methods or technologies that can be used in either face-to-face or online settings. Even, Cronje (2020) recently proposed that blended learning should be understood as the pertinent implication of various theories or methods combined with technology. With this definition, blended learning may not be related to distance education, and any technology integration in the classroom can support the application of this approach.

These various interpretations are not a new issue in blended learning practices. The different interpretations of the approach have been documented since the emergence of the approach. One of the early studies on blended learning recorded that Cooney et al. (2000) used this notion to embark on a new arrangement of children's classroom activities. In their study, they combined the children's "play" element in prekindergarten and the children's "work" element in a kindergarten/first-grade classroom. In this context, blended learning is associated with neither distance education nor technology integration in education. Rather, it blends two elements of learning, play, and work, which are still done in the classroom without technology aid. This initial concept is one of the reasons for the diversity of blended learning definitions among scholars. Therefore, when publishing a special issue journal on blended learning, Whitelock and Jelfs (2003) mention four definitions of blended learning, which are:

- a. the unified mixture of traditional learning with web-based online interaction (taking it out from the creation of Harrison).
- b. the blend of media and tools during the use of e-learning;
- c. the blend of self and group tasks that can be accommodated by online interactions
- d. the mix of some pedagogic approaches, without considering the use of learning technology (putting this definition from the idea of Driscoll).

Scrutinising all these definitions, the researchers believe that blended learning should be understood as the combination of online and traditional teaching instead of the blend of any media during e-learning or the blend of various pedagogical strategies. Once people promote online learning, it has included an alliance of many media and tools usage. It is an entity that normally arises when students deal with e-learning.

Thus, if blended learning is defined this way, it can obscure its difference from online learning. Also, taking blended learning as the combination of methods or approaches in teaching is something that many educators in the world have commonly practised. It is common to apply multiple methods in teaching before the emergence of the blended learning concept. Even, when educators integrate technology during classroom interactions, as proposed by Cronje (2020), it still offers common strategies of traditional teaching that various media such as video or PowerPoint presentations are included to support the teaching and learning process. Thus, Helms (2014) emphasises that any face-to-face teaching that consolidates links, video, or other online sources should not be considered blended learning. In the same vein, Graham (2006) argues that defining blended learning in such a way will let any teaching and learning process be categorised as blended learning, will confer no specific character towards blended learning, and will present no rationales why people are interested in it.

On the other hand, the concept of integrating traditional teaching in the classroom and online interactions through the internet offers novelty, a new concept of education. Different from combining countless methods, approaches, or media, combining face-to-face with online interactions is not a system that has been commonly performed by practitioners before. Graham (2006) believes that when blended learning is defined this way, it brings out the historical side of the approach. In addition, it is utterly specific and can be differentiated easily from other technology integration designs in teaching. Therefore, in the global context, this definition is also confirmed by most of the blended learning scholars.

3.1 Blended Learning Distribution

Another issue related to the concept of blended learning is the fact that students have already learnt something through the internet with or without the teachers' guidance or instruction. Therefore, some scholars propose a more detailed definition, covering the distribution of each learning mode. Allen et al. (2007) argue that to be defined as blended learning, a course should have 30–79% of online learning component. A course with lower online learning is regarded as traditional learning (0%) or web facilitated learning (1–29%), while a course with a higher online learning component is considered online learning. However, this distribution is not a rigid protocol on how blended learning should be arranged. Since blended learning is expected to produce better achievement compared to the traditional classroom teaching only and the independent computer-based course only (Motteram & Sharma, 2009), the organisation can vary based on the context. There is no “the best combination” among the unlimited mixture of possibilities (Moskal et al., 2013). Staker and Horn (2012) argue that if it is systematically designed with some components conducted online and some others taught in school, it can be regarded as blended learning, regardless they are equal or not. Similarly, Graham and Robison (2007) believe that blended learning can be organised by having a fixed schedule of either balance or unbalance online and classroom interactions.

In conclusion, the categorisation should not focus on the percentage of online and face-to-face interactions during the education process. Rather, it is about whether that combination is well-planned to achieve the expected learning outcome. In other words, to be called blended learning, the combination of online and face-to-face interactions should be done on purpose; it should be planned as a holistic teaching and learning process.

This definition is also in line with the blended learning concept proposed by the Indonesian government. The circular letter of the Indonesian government on the application of blended learning in Indonesia states that starting from January 2021, the teaching and learning in higher education could be done by employing hybrid learning or combining the face-to-face and online interactions by considering the health condition of both the educators and learners due to the covid-19 pandemic (see Circular letter of learning organisation in higher education, 2020; Circular letter of learning organisation in vocational education, 2020). In the two documents, there is no strict regulation on how online and traditional teaching should be divided. Each institution may develop the best combination of online and face-to-face interactions based on their needs. Also, the documents declare that the face-to-face teaching the university offers can be in the forms of various teaching activities such as lecture, practicum, studio, field practice, or other teaching activities.

Unfortunately, after reviewing the government's documents related to the blended learning/hybrid learning instructions, the researchers found that the guideline for blended learning preparation and implementation in the document only covers technical stages related to covid-19 safety, such as the stages to follow the recommended health protocol of covid-19 pandemic during the face-to-face teaching, or the instruction to regularly report the condition of classroom interactions, primarily related to students and teachers' health. In the circular letter, the government states that universities should provide facilities and infrastructures for blended learning. However, there is no information on how this approach should be implemented. There is no teaching model or guidance on how the teachers should employ this approach in their teaching and learning process.

4 Blended Learning Models in the World

Once the concept of blended learning is clearly defined, the next question is how this approach should be implemented to effectively improve EFL teaching. Since the instruction to apply blended learning is just encouraged recently in Indonesia, Indonesian EFL teachers need a model to follow. A model is generally a clarification of a theory (Gödek, 2004). Even though there is no best model of blended learning, the model is crucial, especially for those who have just known the approach. In teaching and learning, the teaching models associated with pedagogical strategies are essential as this helps teachers efficiently perform the teaching process. Joyce and Weil (1978) describe the teaching model as a plan pattern that deals with the guidance of choosing appropriate materials and provides relevant protocols to act as a teacher. Since a

model has been developed by considering many important aspects, the imitator can gain better experience by reducing the possibility of creating unnecessary mistakes. Salisu and Ransom (2014) explain that “it would be exceedingly laborious, not to mention hazardous, if people had to rely solely on the effects of their own actions to inform them on what to do” (p. 54).

To find the most appropriate model to follow, the researchers examined various research articles globally which report the practices of blended learning application in English language teaching. From the 17 research articles reporting the implementation of blended learning in English language teaching, the researcher found that 3 researchers developed their models of blended learning by considering the needs of the teaching and learning process or learning theories/pedagogies, while 14 of them followed the blended learning model developed by the pioneer of blended learning. In detail, 11 articles adopt or adapt flipped classroom-blended learning proposed by the American scholars (see Yaroslavova et al., 2020; Mehring, 2018; Buitrago & Díaz, 2018; Wagner-Loera, 2018; Leis, 2018; Turan & Akdag-Cimen, 2019; Busaya & Saovapa, 2018; Nanclares & Rodríguez, 2016; Sung, 2015; Kvashnina & Martynko, 2016; Kadambaevna et al., 2021), 2 of them adopt or adapt the e-moderating model proposed by the European scholars (see Isakova et al., 2020; Farooq & Mahmood, 2014), and one of them adopt the skill-driven model proposed by the Asian scholar (see Kraft et al., 2013). Based on this finding, the researcher then searched for preeminent documents of those three models. It was found that one of them was developed more than ten years ago. However, since it was considered one of the leading models of blended learning, the data were included in the analysis process. The next section presents a review of blended learning models from America, Europe, and Asia the educators adopted or adapted.

4.1 The American Model and Its Implication

Since the initial research on computer learning, online learning, and blended learning is mostly conducted in the United States of America, it is not surprising that most influential blended learning models also come from this continent. In the education context, Staker and Horn (2012) suggest four blended learning models trusted to be the world’s most influential blended learning model. Previously, Staker (2011) observed 40 organisations in America that practised or planned to practise blended learning. By observing those 40 organisations, Staker proposed six blended learning models: face-to-face driver, rotation, flex, online lab, self-blend, and online driver model. After successfully drawing the scholars’ attention to the world by displaying the six models of blended learning, Staker conducted more studies on the blended learning model with her colleague. Staker and Horn (2012) then examined over 80 blended learning programs in the American K-12 sectors and revised her previous work by eliminating the two models due to their similarity with other models. They developed four models that have also been discussed and critiqued by 100 educators during the pre-conference at the International Association for K-12 Online Learning

(iNACOL) Virtual School Symposium. The four blended learning models they proposed are the rotation model, flex model, self-blend model, and enriched-virtual model.

Among those all models, the flipped-classroom model, as part of the rotation model, is the most favoured model adopted by English teachers. Even, 78% of the articles the researchers reviewed implemented flipped classrooms in their English language teaching. As a new pedagogical method, the flipped-classroom model combines asynchronous video teaching, which should be accessed as homework before coming to the class, and active teaching and learning process in the classroom (Bishop & Verleger, 2013). According to Sit and Guo (2019), various videos students accessed during flipped classroom were beneficial in their learning process as they promoted authentic language materials. In the same vein, Mehring (2018) argues that this kind of model can create more communicative EFL teaching. Thus, Turan and Akdag-Cimen (2019) found that studies on flipped-classroom model in English language teaching have been improving since 2014.

4.2 The European Model and Its Implication

In the European context, the UK Open University can be considered the pioneer of online learning and blended learning. A prominent model of blended learning developed by Gilly Salmon was firstly used at this university. The five-stage model proposed by Gilly Salmon was initially designed for online learning, but then it is also relevant for the concept of blended learning. Salmon et al. (2010) described that Salmon studied, proposed, and tested the five-stage model in the 1990s before publishing it in 2000 and 2004. Her five-stage model covers the access and motivation stage, online socialisation stage, information exchange stage, knowledge construction stage, and development stage. Having developed this model, she collaborated with David Jaques to write how to employ this model in blended learning (see Jaques & Salmon, 2006). Their model has since then attracted the attention of many scholars in the UK and other countries.

In the Ukraine context, Isakova et al. (2020) designed a blended learning course for English language teaching in higher education by following Salmon's five-stage model. They propose that there was a positive change in blended learning practices in the third trimester of its application. Furthermore, the model was proven to be successful in enhancing learners' professional and communicative competence and activating their potential in learning. Even at the end of the academic year, the students were able to confidently communicate with overseas students through online media, read scientific journal articles written in English, and become part of the professional online association.

4.3 *The Asian Model and Its Implication*

In the Asia continent, the blended learning model introduced by Valiathan (2002) is deemed the most widely recognised model. Unlike other researchers, Valiathan (2002) introduced three blended learning model based on the learning objective. They can be described as follows:

- a. Skill-driven learning: it combines individual or independent learning with teacher support to develop certain knowledge and skills
- b. Attitude-driven learning: it integrates many activities and delivery media to develop certain behaviours
- c. Competency-driven learning: in this model, the combination of teacher support, knowledge management, and tools is aimed at developing workplace competencies.

This model has been adopted and studied by many scholars in various fields. One of the research articles the researchers reviewed was written by Kraft et al. (2013). They implemented skill-driven learning in Romania's two military English courses. The first course adopted the skill-driven learning model with 40 (forty) hours over 8 (eight) weeks of self-study by using the CD, followed by 2 (two) weeks of face-to-face teaching and learning to develop skills in an integrated manner, especially speaking skill. The second English course was conducted for 10 (ten) weeks, in which 7 (seven) weeks were held online. After conducting a study in these two classes, they concluded that the face-to-face session and the live e-learning in this model avoid the students' feeling of loneliness in the study. It then successfully helped the students in completing the self-paced modules.

Unfortunately, not all of the blended learning implementations that follow the available model produce a good result. In some cases, those models did not work well as expected. The next section discusses how the models worked or did not work in a particular setting.

5 Discussion

As previously reviewed, the available blended learning models are reported to be beneficial in EFL teaching. However, if the practice is closely examined, the success is only reported in areas where the model is developed. For example, in the United States of America (USA), many scholars have published how the flipped classroom model has successfully reinforced the English teaching and learning process. Buitrago and Díaz (2018) implemented a flipped classroom in English courses for undergraduate students at Universidad de la Sabana, Colombia. After the flipped-classroom implication, they concluded that this approach is practical to improve students' writing in English and increases their motivation to exploit technology for language learning. Wagner-Loera (2018) conducted research at the University of Maryland, USA, by

bringing the flipped elements to English class that previously employed the reduced cognitive load classroom (RCLC) approach. The research was conducted mainly in the reading, writing, and grammar course. The flipped classroom ran well because it let students learn primarily at home, and then once they came to the school, they had more time to practise what they had learnt. Wagner-Loera (2018) states that since the students can learn at their own pace, their cognitive load is reduced. As a result, the students become more autonomous in learning, creating better confidence and performance in English. In the same vein, other articles from Western countries reported the success of this model in their English language class (e.g. Kvashnina & Martynko, 2016; Nanclares & Rodríguez, 2016; Yaroslavova et al., 2020).

Unfortunately, when this approach is implemented outside the Americas, the outcome is not always satisfying. Leis (2018), who studied the implementation of flipped classroom in the Japanese education context, asserts that even though flipped classroom promotes students' linguistic self-confidence, it may hinder the teachers and students from getting maximum advantages from their class time and may raise the teachers' difficulty. Also, after reviewing 43 articles from Taiwan, China, Turkey, and Arabia, Turan and Akdag-Cimen (2019) found that besides its benefit in enhancing engagement and developing autonomy, flipped classroom offers many challenges reported in some research such as providing extra workload for both teachers and students, challenging to be implemented due to the internet or technology-related issues, and increasing students' anxiety in particular English skill (writing). Likewise, when this model is implemented in Korea, Sung (2015) reported that although the students perceived the implementation positively, there were many difficulties both the teacher and students have to face related to test-oriented teaching, students inequity in terms of English proficiency and learning experience, lack of support from the university, as well as the more challenging effort and preparation for the educators. Research conducted by Busaya and Saovapa (2018) indicated that with modification, the flipped classroom provided a beneficial contribution in their English class, in Bangkok. However, in their paper, information on how they modified the model is not clear.

These different findings are reasonable because the flipped classroom model is developed in the western countries (USA) whose socio-cultural and educational contexts are different from those of Asian countries. For example, the study of Wagner-Loera (2018) found that the students' independent learning before coming to the class made them more ready during the teaching and learning process in the classroom. Also, since they could learn individually based on their own pace during online learning, their cognitive load could be reduced. Therefore, the students became more autonomous and confident in using the language. Considering the American culture that tends to be more individualist ("Country comparison", 2021), and thus impacts the students' characters, implementing blended learning which requires students to perform independent learning will be likely unproblematic. This learning approach is aligned with the students' individualist culture. However, when this approach was implemented in Asian countries with different students' and teachers' characteristics, the results were different. Even though blended learning was also reported to be able to develop students' autonomy, Turan and Akdag-Cimen (2019) found that some

students became more anxious in learning English. Also, the inequity of students' learning experiences was reported to be an obstacle during the blended learning implementation (see Sung, 2015). Tempelaar et al. (2013) argue that cultural background gives a significant contribution to the success of the educational design. Their studies also revealed that cultural factors influenced the students' learning approach and their earnestness in using online learning during blended learning practices. Hence, for finding an appropriate model for Indonesian EFL teaching, those models should not be adopted directly. Instead, those models should be regarded as references. However, the literature introducing and describing these blended learning models can provide teachers and educators in Indonesia with fundamental knowledge in theoretical concepts and valuable practical references when the researchers consider issues of English language teaching and learning in relation to blended learning. As advocated by McCarthy (2016), programs of blended learning that connect theories and blended learning training models and strategies can be developed and evaluated to build on a sound understanding of what generally constitutes best practices in language teaching and learning.

5.1 Examining Blended Learning Model Through the Lens of Socio-cultural Dimension

Taking into account the socio-cultural context before implementing a specific approach in education is imperative. Hofstede (2001) defines culture as "the collective programming of the mind that distinguishes the members of one group or category of people from another" (p. 9). Culture impacts people's values which then influence their behaviour, including their way of teaching and learning. Joy and Kolb (2009) believe that culture influences learning style, especially in determining learners' choice towards abstract or concrete conceptualisation. Therefore, in the direction of finding the appropriate model for Indonesian EFL teaching, the researcher then scrutinised the available models through the lens of the Indonesian socio-cultural context.

For this reason, the three of five socio-cultural dimensions proposed by Hofstede (2001), which are power distance, individualism vs collectivism, and uncertainty avoidance, are used to probe the characteristics of Indonesians, especially university students. These three cultural dimensions are employed as they are relevant to the education field. First of all, power distance describes the degree of relationship that is hierarchically ordered. Joy and Kolb (2009) explain that in the education sector, the community that is high on power distance acknowledges the teachers' authority and wisdom more than the community that is low on power distance. Secondly, individualism vs collectivism presents how individuals prefer to act in the community, either as an individual or a group member. Joy and Kolb (2009) believe that "collectivism perhaps is the most widely used dimension to differentiate between cultures" (p. 74). In the field of education, students acting as an individual and group

members influence their way of learning. Thirdly, uncertainty avoidance describes how the community prefers the structured condition rather than the unstructured one. Those who experience high uncertainty avoidance tend to expect a structured learning process with a clear teaching goal and schedule. According to this cultural dimension, Indonesia's power distance is high, individualism is low, and uncertainty avoidance is moderate ("Country comparison", 2021). With this information as a basis, the researcher then analysed whether the available model fits these cultural dimensions to put forward a culturally appropriate blended learning model.

The first model considered the most influential model in English teaching is the flipped classroom. This model encourages students to access a video or multiliteracies before coming to the classroom. The students are encouraged to learn individually through online interactions and then practise their skills during face-to-face teaching in the classroom. As the schedule of online and classroom interactions is clear that the students should have their online learning before going to school, the Indonesian students who have a moderate level of uncertainty avoidance will feel comfortable as they engage in a well-planned education system. Besides, getting ready before coming to the class is a good strategy as it will reduce the teacher's explanation time in the classroom and give students more opportunity to practise the language. Since Indonesian students have minimal opportunities to use English outside the classroom (Nuraini, 2019; Sulistiyo, 2016), this model should promote improvement, especially in students' productive English skills, including speaking and writing. Also, as Indonesian students' proficiency varies, assigning them to learn independently using online instructions can allow them to learn based on their own learning pace and ability. Then, once they are ready with sufficient knowledge, they can learn together with their friends and teacher in the classroom. This concept supports the collectivism dimension that they have, so that this model has the potential to be the appropriate blended learning model for the Indonesian EFL students.

However, Indonesian students have a large power distance dimension. They tend to believe and give full respect to teachers so that they tend to always rely on teachers' instruction. Consequently, requiring them to study independently before coming to the class will be very challenging. Cirocki et al. (2019) found that Indonesian students "were not yet ready to act independently, lacking various skills and competences typical of autonomous learners" (p. 13). Thus, providing a video for them to learn individually through the internet will not work for them. The students may have no idea on what to learn from the video or how to expand their knowledge related to the given video. As a result, they are still not ready to directly practise the language when they come to class. On the other hand, as the teachers' explanation time has been reduced to provide more communicative activities, students may lose the opportunity to understand the language. In their study, Ghufuron and Nurdianingsih (2020) found that flipped classrooms did not run well because the students find it hard to understand learning materials independently before coming to the class.

The second blended learning approach to be discussed is the five stages, including the phases of access and motivation, online socialisation, information exchange, knowledge construction, and development. This model guides to perform the best role of a moderator or instructor when implementing blended learning pedagogical

strategies in different phases of the teaching–learning process. These five stages are believed to be beneficial to organise an effective blended learning program. Since this model focuses on what teachers should do to assist students during the blended learning program, it is suitable for Indonesia’s power distance value. Unlike the flipped-classroom model which requires students to solely work on their own learning before coming to the class, this model provides instructions for teachers to encourage and assist the students during the teaching and learning process. Such a model is urgently needed by Indonesian students.

Unfortunately, even though Jaques and Salmon (2006) have explained how this model can be implemented in blended learning practices, this model does not clearly point out how face-to-face interactions should be arranged. Therefore, practitioners should conduct some adaptation once they decide to adhere to this model for their blended learning class. Heinze and Procter (2004) argue that since the side of traditional teaching is not included in the model, the implication of this model for blended learning becomes finite. As Indonesian students prefer to learn in a group rather than individually, explicit instructions on how face-to-face teaching should be conducted should also be highlighted. Otherwise, it is not only irrelevant with their collectivism value but also may create uncomfortableness due to the uncertainty of traditional classroom experiences.

Finally, the third model is the skill-driven learning model proposed by Valiathan (2002). This model is adapted to English teaching as it is designed to develop specific knowledge and skills. Generally, when it is implemented in EFL teaching, it will combine individual or independent learning with the teacher’s support. Emphasising the role of the teacher in supporting students is the advantage of this model that is in line with the power distance value of Indonesian students. However, as it focuses more on the interaction of students as an individual and the teacher, it may not strongly support the value of collectivism in Indonesia. In Indonesia, as students have high collectivist values, the students not only need a teacher to provide guidance but also need to meet and learn the foreign language together with their friends. Thus, classroom interactions as the place to communicate using the target language should also be planned well.

5.2 Recommendations for EFL Teaching in Indonesian Higher Education

Since blended learning has been practised and examined by many academics/researchers in the world, especially those who come from Western countries, it is acknowledged that some blended learning models have been developed and tested satisfactorily to be implemented in the English language teaching context. However, it is also important to notice that as they are developed in Western countries which have socio-cultural context different from that of Indonesia, evaluation and adjustment may need to be done and explored.

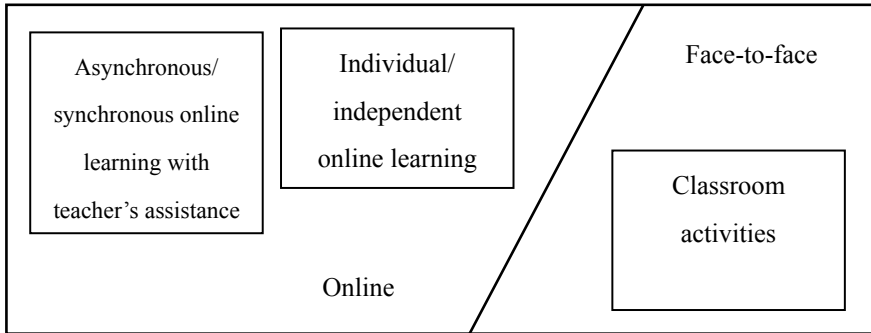


Fig. 1 Integrated blended-learning model for EFL teaching in Indonesian higher education

Considering the fact that practising the language may significantly improve students’ language proficiency, it is not surprising that flipped classroom is widely adopted or adapted by many scholars due to its advantages in providing more opportunities to practise the language in the classroom. However, since this model does not really support the power distance value during its implementation, this model should be integrated with other models to fit the Indonesian students’ needs. The researchers propose the integrated blended learning model for EFL teaching in Indonesian higher education by considering the benefits and suitability of each existing model in accordance with the Indonesian socio-cultural context. The integration of the blended learning model can be described as follows (Fig. 1).

Generally, students will experience the blend of online and face-to-face teaching in three stages. In the first stage, adapting the flipped-classroom concept, the students should prepare themselves before coming to the class by learning the materials online. However, since the students have large power distance dimensions and may find it challenging to study without a clear guidance or instruction from teachers, this online session should be assisted by the teacher. The idea of putting together the individual learning and teacher’s support in this stage is adapted from the concept of the skill-driven blended learning model proposed by Valiathan (2002). Furthermore, during this stage, the teacher will assist the students by adapting the five-stage model proposed by Jaques and Salmon (2006). The teacher should assist the students with the motivation issue, access, online socialisation, information exchange, knowledge construction, and development. This stage can be either synchronous or asynchronous, but the plan should be explained to the students before the program runs as they may not be comfortable with unexpected things.

After that, the students should experience the second stage, in which they individually and independently access any additional information related to the materials through asynchronous online learning. Because the students have received instructional scaffolding and support from the teacher in the previous stage, it is expected that they will be able to develop their independent learning skills and become autonomous learners while improving their English.

Finally, the last stage will be face-to-face interactions in the classroom. In this stage, as the students have received much support from the teacher during the English online lecture and individual online study, they should be able to practise the target language with their friends in the classroom and to engage in various classroom activities that give them more opportunities to enhance their English skill.

This integrated blended learning model should provide a theoretical and practical framework for the design of a teaching model for EFL teaching in Indonesian higher education context. As scholars further support, the idea of using digital humanities pedagogy, as a hot topic in second language education today, is to involve teachers to position themselves at the intersections of humanities and information technologies and investigate how blended methodologies can be applied to transform and enhance teaching–learning in language education (Sit & Chen, 2019; Sit & Guo, 2019).

6 Conclusion

The rapid development of ICT and the covid-19 pandemic have pushed the Indonesian government to consider blended learning as a new approach for Indonesian higher education, including in the EFL teaching context. However, regardless of its popularity, many Indonesian EFL teachers in Indonesia find it challenging to understand and implement this approach. Through the literature studies, it can be proposed that blended learning should be understood as the systematic planned of online and face-to-face teaching and learning processes in which the distribution of each mode may vary depending on the needs and objective of teaching. For EFL teaching in Indonesian higher education, the researchers propose an integrated blended learning model developed through the analysis and synthesis of available references on effective blended learning models and by considering the socio-cultural context of Indonesia. The integrated model covers three stages of the EFL teaching and learning process: an asynchronous or synchronous online learning with teacher's assistance by adapting the five-stage model (access and motivation, online socialisation, information exchange, knowledge construction, development), individual online learning, and classroom activities. These stages should be conducted in order with a clear schedule to provide comfortable teaching and learning setting.

After all, the proposed integrated model should provide a beneficial contribution to the blended learning practices in Indonesian EFL teaching. As the Indonesian government has encouraged the implementation of blended learning, the results of this research should be used as one of the primary references for English practitioners in Indonesia. Also, the proposed model should be a useful reference for any English practitioners, especially those who come from Southeast Asian countries, as they may share similar socio-cultural contexts with Indonesian practitioners.

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Communication Noise in E-learning During the Pandemic and How to Reduce It: Perspectives from University Students and Teachers



Zhao Xun Song, Jing Wu, and Hsin Li Hu

Abstract The higher education ecosystem changed greatly during the COVID-19 pandemic, and it now appears that the post-pandemic “new normal” will involve online education, mixed-mode teaching, and blended learning models. Despite an abundance of studies of e-learning in general, few evidence-based studies of the barriers to the effectiveness of online education have taken into account the perspectives of both teachers and students. This study adopted both qualitative and quantitative methods to reveal the main types of physical noise, psychological noise, and semantic noise encountered in e-learning and identified commonly used and effective noise reduction methods. This evidence-based study of the effectiveness of e-learning during the pandemic demonstrates and testifies to the feasibility of providing quality education online during the pandemic and beyond it. The findings of this study have numerous significant practical implications for educators, students, and researchers. It also contributes to the literature on e-learning from a communication noise perspective.

Keywords Online education · Pandemic · Communication noise · Effectiveness

1 Introduction

E-learning is not new. Even before the COVID-19 pandemic, there was already rapid growth in and widespread adoption of education technology around the globe. However, when face-to-face learning came largely to a halt during the pandemic, the

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nature of education changed dramatically, with a significant surge in e-learning on digital platforms.

E-learning during the pandemic has received significant research. Most studies have focused on the response of higher education institutions to COVID-19 and the challenges involved in e-learning and their solutions during the pandemic. There have, however, been few evidence-based studies of the impact of the pandemic on academic outcomes and even fewer studies on communication barriers in online learning from the perspectives of both students and teachers.

This study aimed to reveal the typical types of communication noise encountered in e-learning and identify effective noise reduction methods used by teachers and students during the pandemic. It also aimed to provide an evidence-based evaluation of the effectiveness of online teaching and learning during the pandemic.

2 Literature Review

To contain the spread of COVID-19, schools and higher education institutions (HEIs) in 185 countries had closed by April 1, 2020, affecting 1.5 billion learners, according to a report by UNESCO (IAU Global Survey Report, 2020). Since the start of the pandemic, online teaching has been one of the main ways of delivering education. There has been a dramatic increase in research on e-education around the globe. A search of Google Scholar for studies of online learning and teaching during the COVID-19 period in 2020 returned 960 results (Mseleku, 2020). Research on the impact of the pandemic on e-education covers a vast spectrum of online teaching and learning practice, ranging from studies that look at the global level, such as “The impact of COVID-19 on higher education around the world” (IAU Global Survey Report, 2020), through to those that focus on the regional or country level, such as “Students’ perception and preference for online education in India during COVID-19 pandemic” (Muthuprasad et al., 2021), to those that examine the response in specific institutions, such as “COVID-19 and online teaching in higher education: A case study of Peking University” (Wei, 2020). A wide range of research themes has been covered (Mseleku, 2020), including difficulties in adjusting to the “new normal” faced by lecturers and students (e.g., Chang & Fang, 2020; Chen et al., 2020; Donitsa-Schmidt & Ramot, 2020; Goh & Sandars, 2020; Teras et al., 2020), Internet connectivity issues (e.g., Farooq et al., 2020; Kapasia et al., 2020), uncondusive physical environments (e.g., Olajier, 2020; Rotas & Cahapay, 2020), mental health-related issues (e.g., Giallonardo et al., 2020; Mheidly & Fares, 2020), and lack of teaching and learning resources (e.g., Coman et al., 2020; Joshi et al., 2020), among others.

Research coverage of the impact of COVID-19 on different educational fields has been uneven. For example, ample research has been done in the medical education field. More than 40 research papers on the effect of the pandemic on medical education have been published in the *Journal of Medical Education and Curricular Development* alone. Comparatively, a thorough literature review only reveals a few

papers on the strategies adopted by educational institutions teaching journalism and communication in facing the COVID-19 pandemic.

Searching the literature also shows that most studies on online learning amid the COVID-19 pandemic have focused on the students' perspective (e.g., Adnan and Anwar, 2020; Cao et al., 2020; Owusu-Fordjour et al., 2020). Some studies have focused on online teaching from the teachers' perspective (e.g., Code et al., 2020; Hassan et al., 2020). Fewer studies have looked at both teachers' and students' perceptions and concerns with regard to online education in the wake of the pandemic.

The most frequently studied topics are barriers, difficulties, challenges, obstacles, and problems in online teaching and learning during the pandemic. There has not yet been an attempt to study e-education from a communication noise perspective. In communication studies, noise refers to anything that interferes with the effectiveness of the communication process between a speaker and a receiver.

Communication noise can be divided into four major categories (DeVito, 2010): physical noise, psychological noise, semantic noise, and physiological noise. Physical noise is any external or environmental stimulus that distracts us from receiving the intended message sent by a communicator, such as a loud party at the neighbors' while one is trying to make a recording. Psychological noise refers to interference due to attitudes, ideas, and emotions experienced during an interpersonal interaction, such as stereotypes or preexisting thoughts. A typical example is when someone representing a political party with which you disagree suggests a solution to a problem; one may refuse to listen because one has decided in advance that whatever they have to say is wrong. Semantic noise is a communication barrier that arises due to confusion over the meaning of words, such as when the sender of the message uses a word or a phrase of which we don't know the meaning or that we use in a different way from the speaker. Physiological noise refers to disruption due to physiological factors, such as hearing problems, illness, and memory loss.

There is a lack of scientific research evidence on the effectiveness of e-education amid the pandemic, and further research on its impact on academic outcomes is much needed (Mseleku, 2020). This study attempted to contribute to the understanding of the online communication process from a communication noise perspective. In view of the nature of the study, we focused on three types of noise in e-education: physical, psychological, and semantic noise.

3 Research Questions and Methods

This study attempted to conduct evidence-based research on e-education practices from the perspectives of both teachers and students at the School of Communication (SCOM) at the Hang Seng University (HSU), a private university in Hong Kong. Due to the outbreak of the pandemic, all face-to-face teaching at HSU was switched to online teaching in Semester 2 of the academic year 2019/2020.

The research questions of this study are as follows:

1. Do you encounter physical noises, psychological noises, and semantic noises in the e-learning process? If yes, what are they?
2. What methods can students/teachers adopt to effectively reduce such noise?
3. How do students and teachers evaluate the effectiveness of online learning and teaching during the pandemic?

The study used both qualitative and quantitative methods. In-depth interviews were conducted to seek answers to the first two questions. The third question aims to go one step further to test the performance of teachers and students despite all the noises encountered in e-learning. A survey was administered to assess the effectiveness of e-learning during the pandemic.

The study recruited a total of 26 undergraduate students. The participants (N = 26) were 43% male (n = 11) and 58% female (n = 15). A total of 72% of the students (n = 18) were locals from Hong Kong, whereas the other 28% (n = 8) were students from mainland China. Among the interviewees, 23% (n = 6) were living in the university residence halls. Twenty-one were interviewed online through Microsoft Teams, and five participated in face-to-face interviews.

Twelve teachers (N = 12) were invited to participate in the interviews. Among them, 77% (n = 9) were full-time teachers and 23% (n = 3) were part-time teachers. Four of them taught practical modules. All of them were interviewed in person.

The survey was conducted by the university Teaching and Learning Quality Committee from April 20 to May 11, 2020 to collect students' and teachers' opinions about the effectiveness of online teaching and learning. A total of 22 teachers and 89 students from the School of Communication completed the survey.

4 Research Findings

The interview data were interpreted and analyzed using a thematic content analysis method involving initial coding, category development, and thematic coding. The following themes related to communication noise and methods of noise reduction in online learning emerged.

4.1 Communication Noise from the Students' Perspective

4.1.1 Physical Noise

The students revealed that they encountered various physical or environmental noises during the course of online learning. The three most frequently mentioned noises in this category were the following.

Problems with the living environment

Aspects of the living environment can pose a major challenge to the effectiveness of e-learning. The factors mentioned most often included narrow living spaces at home, especially for locals; constant disturbances by family members; having online classes at the same time as roommates; traffic noise outside; and occasional fire alarms in the building. A local student revealed the following:

My family living conditions are not very good. My little brother is also having online classes at home. He is taking the DSE exam this year. In order not to disturb his studies, most of the time I go out to find a place to study, for example, the public library. (Student Interviewee 21).

Online teaching platform problems

Especially at the very beginning of the pandemic, students found it stressful that different teachers used different platforms. They had to download several apps, such as Zoom, Teams, Tencent, or others. They agreed that neither teachers nor students were ready for online education and that both were unfamiliar with the platforms' functions. As one interviewee put it:

Teachers and tutors should be trained how to use Teams effectively. It was really a waste of time when they dealt with technical issues during the class with all the students waiting online. (Student Interviewee 8).

Internet connectivity problems

Internet connectivity was a concern for students in mainland China and students in the residential halls. Mainland students had to use virtual private networks (VPNs) to access the teaching materials in the university Moodle system and to communicate with their teachers, who used Gmail to keep in touch with them. The VPNs seldom functioned smoothly. Some residents complained about the weak Wi-Fi signal in the dorms (Table 1).

The main physical noises are presented in the following table.

The main ways suggested by students to reduce the above types of physical noise included more IT training for teachers and tutorials for students, enhancing the university's IT infrastructure, providing recorded lectures for students to review and refer to after class, and providing quieter places for students to study.

4.1.2 Psychological Noise

The students agreed that psychological noise affected them even more strongly than physical noise. The following themes were identified.

Pressure to turn on the webcam or microphone

The majority of the interviewees felt pressured when the teacher urged them to turn on their webcam or microphone. The reasons for this ranged from "having a live webcam will restrict our freedom to move around at home" (student interviewee

Table 1 Physical noises from the perspective of SCOM students

Physical noise	Mentions	% of students (N = 26) (%)	Examples
Problems with living environment	20	76.9	Narrow living space at home; constant disturbances by family members; occasional fire alarms at the dorm, etc
Problems with teaching platform	14	53.8	Different platforms adopted by different teachers; unexpected malfunctions of the platforms, etc
Problems with Internet connectivity	8	30.7	Weak WIFI signal at the dorm; instable VPN to get access to the teaching materials for the students in mainland China, etc.,

12) to “my room was small and messy” (Student Interviewee 7). For example, one student explained:

I feel embarrassed or shy if my answer is wrong, not only before my classmates in the virtual classroom but also in the presence of my family members at home. (Student Interviewee 15).

Becoming fatigued after long hours of online lectures

Quite a few students felt exhausted or fatigued after long hours of lectures because of the reduced level of interaction among teachers and students and their own shortened attention span. They became fatigued easily during online lectures, especially when they had to wear earphones all the time.

My roommate and I sometimes have online lectures at the same time. So we have to wear earphones in order not to disturb each other. It's too exhausting and gets hard to bear after two or three hours. (Student Interviewee 11).

Little motivation because of the comfortable environment

More than half of the student interviewees mentioned that they did not feel very motivated during e-learning because of the comfortable and unrestricted environment at home or in the residential halls.

You can do anything you want during the course of the online lectures: play games, eat or drink, text message friends, etc. (Student Interviewee 7).

Feeling vexed with free-riders

Quite a number of students admitted that the phenomenon of free-riders in group projects and even surrogate exam-takers had become more common in the online learning context. Lack of in-person communication was regarded as the cause of the

Table 2 Psychological noises from the perspective of SCOM students

Psychological noise	mentions	% of students (N = 26) (%)	Examples
Pressured to turn on webcam or microphone	23	88.4	Live webcam restricts freedom to move around at home; feeling of being under surveillance, etc
Fatigued after long hours of online lectures	11	42.3	Shortened attention span; Zoom fatigue after hours of online lectures, etc
Less Motivated in e-learning	8	30.7	Comfortable environment at home; great freedom to do anything, etc
Vexed with free-riders	5	19.2	Mad at free-riders in group projects and surrogate exam-takers

phenomenon. They thought it was unfair for those students to receive the same scores as other group members.

Table 2 shows the summary of the main psychological noises perceived by SCOM students.

In terms of ways to reduce psychological noise, the students stated that they would rather the teachers did not insist on their turning on the webcam. They preferred typing their questions or answers as opposed to using the microphone. They suggested shortening the online lectures to make the e-learning experience more palatable. Peer evaluation by groupmates was proposed as a way to deal with the free-rider problem.

4.1.3 Semantic Noise

When the students encountered difficulties in encoding what the teachers were teaching them during e-learning, they were suffering from semantic noise.

Language problems

English is the major medium of instruction in the university. However, the local students prefer teachers to use their native language (Cantonese) in online lectures because “our native language is much easier for us to understand, especially without the nonverbal cues from the teachers” (Student Interviewee 7). The situation was different for students from mainland China: “when the teacher uses Cantonese in lectures, we mainland students have a hard time” (Student Interviewee 11).

Table 3 Semantic noise from the perspective of SCOM students

Semantic noise	Mentions	% of students (N = 26) (%)	Examples
Language problems	14	53.8	Difficulty in understanding online lectures in English without nonverbal cues from the teacher
Problems with special terms or jargon	8	30.7	Not familiar with some special terms or jargons

Problems with special terms or jargon

Some interviewees blamed the use of jargon or specialized terminology associated with a particular field for increasing the difficulty of understanding online lectures (Table 3).

The table below shows the semantic noises perceived by the students.

To overcome the semantic noise in e-learning, the students recommended that teachers upload recorded lectures for students' review after class. They also suggested that teachers make use of the whiteboard features and type special terms or jargon on the screen.

4.2 Communication Noise from the Teachers' Perspective

4.2.1 Physical Noise

In response to the question about physical noise, teachers focused on the online teaching platform features and the challenges they faced in teaching both theory modules and practical training modules, as well as the difficulties they experienced in conducting mixed-mode lectures.

Problems with online teaching platforms

The teachers' greatest concerns included unexpected technical problems during the lectures, unstable Internet connections, whistling noises from the speakers when the students turned on their microphones, delays in video playing, and limited uploading capacity for teaching materials, such as prerecorded lectures, to the Moodle system.

Problems with mixed-mode teaching

When the situation of the pandemic improved, the university began requiring teachers to conduct face-to-face classes in classrooms according to an assigned timetable, with simultaneous live broadcasts via Teams (or other online means adopted by individual teachers). This kind of mixed-mode teaching involved major challenges for the teachers because the majority of the students were online, and only a small number of them were back in the classroom. "To whom should I pay more attention?"

(Teacher Interviewee 5) The majority of the teacher interviewees preferred full online lectures in their offices, which have better acoustics, to lectures in the classroom with only a few students or sometimes even no students present.

“I had to wear a mask even if only one student came to the classroom. I had a hard time lecturing for hours with a mask on.” (Teacher Interviewee 5).

Problems with teaching practical modules

Teachers of practical modules faced more challenges than teachers of theoretical modules. For practical modules such as TV production and multimedia design, students need hands-on experience and practice. Therefore, blended teaching was required, with online lectures on theory first and in-person training in the studio later. Students stranded in mainland China were unable to return to the university for in-person training and thus could not take those modules. The teachers soon found that the students had almost completely forgotten the theory when they came to the practical part. In addition, in-person training increased their teaching load because they had to divide the students into small groups for practical training to meet the social distancing requirement (Table 4).

The main physical noises perceived by the teachers are presented in the following table.

To reduce the physical noise caused by the unique features of online teaching platforms, almost all teachers said they attended IT training for teachers. When conducting mixed-mode teaching, they gave priority to online learners, especially when only a small number of students were present in the classroom, as they were able to interact with the latter students after the lecture. Some practical module teachers found recorded lectures useful because students could watch the practical procedures again after class.

Table 4 Physical noises from the perspective of SCOM teachers

Physical noise	Mentions	% of students (N = 12) (%)	Examples
Problems with teaching platform	11	91.6	Unexpected technic problems; delay in video playing; limited uploading capacity in Moodle system, etc
Problems with mixed-mode teaching	9	75	Difficulties to deal with students both online and in the classroom simultaneously
Problems with teaching practical modules	4	33.3	Limited and insufficient time of in-person training, workload increase due to smaller-group classes to meet social distancing requirements, etc

4.2.2 Psychological Noise

The teachers noted that they were subject to worries, pressures, stress, anxieties, and other psychological tensions or emotions about online teaching.

Worries over unexpected malfunctioning of teaching platforms

Almost all interviewees agreed that what worried them most was the sudden breakdown or malfunction of teaching platforms during the course of a lecture. One teacher illustrated his worries with the following case:

Once during the lecture, the students couldn't hear me. It took nearly 20 min before I could get it right. I felt sorry that the whole class was waiting online, and I worried a lot about possible complaints from the students. (Teacher Interviewee 3).

Worries about students' complaints

Some teachers felt that students complained more about online teaching than about in-person teaching. Complaints from students ranged from the change of module assessments, the lecture length, and attendance-taking practices to the mixed-mode requirements, which increased the pressure on teachers.

Reluctance to record the online lectures.

The university encouraged teachers to record the online lectures or to upload the prerecorded lectures to facilitate study and review by the students. Although most teachers agreed that recording lectures had benefits, quite a number of them felt reluctant to do so for two main reasons. The first was concern about the possibility of students screenshotting some of the teachers' comments about sensitive topics such as the local social movement and uploading them to the Web. The other was that they found that the prerecorded lectures would encourage the students to skip the online classes because they might think they could review the lectures anytime later (Table 5).

The main psychological noises identified from the interviews with the teachers are summarized in the following table.

To reduce such psychological noise, the teachers would attend IT training to familiarize themselves with the platforms' functions. They would explain clearly to students why online lectures were not recorded and make known the changes and new arrangements to students at the very beginning of the semester.

4.2.3 Semantic Noise

The teachers were most concerned about whether students understood the contents of e-learning. They also identified language and special terminology as the major source of semantic noise.

Table 5 Psychological noises from the perspective of SCOM teachers

Psychological noise	mentions	% of students (N = 12) (%)	Examples
Worried over platform problems	12	100	Worried most about unexpected malfunctions of the platforms in e-learning
Reluctant to record online lectures	7	58.3	Concern about comments on sensitive topics being screenshot and circulated on the Web; encouraging students to skip online class, etc
Uneasy about students' complaints	4	33.3	Possible complaints about the change of module assessments, the attendance-taking practice, the mixed-mode requirements, etc

Language problems

Most teachers admitted that the students' English language proficiency was relatively poor. "They will lose interest in my lecture and probably leave the virtual classroom if they don't understand me in English." (Teacher Interviewee 11) According to the end-of-class feedback from the students, using the students' native language as the major medium of instruction was conducive to a better understanding of the content being taught.

Problems with special terms or jargon

The teachers also regarded special terms, jargon, homophones, and ambiguous words as sources of semantic noise in online education. The fact that there was little or no interaction between the teachers and students was a cause of such semantic noise. As one teacher put it: "Without nonverbal cues from students in online lectures, I didn't realize they misunderstood certain concepts or terms until I graded their after-class assignments." (Teacher Interviewee 7).

Table 6 below presents the two main semantic noises perceived by the teachers.

To reduce the semantic noise in e-learning, the teachers said that they tried every means, such as providing lecture notes in PowerPoint form in both English and Chinese, making use of the whiteboard features, typing special terms or jargon on the screen, and providing recorded lectures for students' reference afterward.

Table 6 Semantic noises from the perspective of SCOM teachers

Semantic noise	Mentions	% of students (N = 12) (%)	Examples
Language problems	8	66.6	Students' insufficient English in understanding the lectures
Problems with special terms or jargon	5	41.6	Some special terms or jargons hindered students' understanding; confusion of some homophones, etc

4.3 Effectiveness of Online Teaching and Learning

Evaluation of teaching and learning often comes in the form of a questionnaire that asks teachers and students to rate their performance on a Likert-type scale. Teachers and students may be required to assess various aspects of teaching and learning, from teaching content to specific teaching practices and behaviors.

Two sets of questions were constructed. The Survey on Online Teaching and Learning (Teachers) was designed to reflect teachers' online teaching practices and measure their feedback on the use of technologies and interaction with students. The Survey on Online Teaching and Learning (Students) was designed to reflect the teachers' online teaching practices from students' perspectives and measure the feedback from students on their learning experiences and supports received from their teachers.

4.3.1 Survey on Online Teaching and Learning for Teachers

The survey was divided into two parts. The first part (Q1–Q6) was designed to reflect teachers' online teaching practices. The results are shown in Table 7.

Part 2 (Q7–Q15) was designed with a 6-point scale to measure teachers' feedback on the use of technologies and interaction with students, where 6 represents “Strongly

Table 7 Responses to Q1 to Q6 (SCOM teachers)

Questions	SCOM (%)
Q1. I conducted my online classes according to the scheduled timetable	100
Q2. I shared my recorded audio/video lectures online after class	83.3
Q3. I taught with prerecorded audio/video lectures	16.6
Q4. I engaged my students in online live classroom discussions	100
Q5. I held live online consultations after class for my students	83.3
Q6. I gave assignments/projects to improve my students' learning via online teaching platforms (e.g., Moodle)	100

Table 8 Individual question average for Q7–Q15 (SCOM teachers)

Questions	SCOM
Q7. I conducted live audio/video lectures smoothly via Microsoft Teams or other online teaching platforms (e.g., Zoom, Google Meet, etc.)	4.83
Q8. I received helpful technical support from the IT Department for my online teaching (e.g., workshops, online chatbox, etc.)	5.25
Q9. My students attended my online classes according to the scheduled timetable	4.67
Q10. My students actively engaged in online live classroom discussions	3.33
Q11. My students asked questions during online live audio/video lectures	4.00
Q12. My students sought help from me via live online consultation after classes	4.33
Q13. My students sought help from me via other means after class	4.75
Q14. My students were able to take quizzes/tests smoothly via online teaching platforms (e.g., Moodle)	4.08
Q15. Overall, I found that teaching and learning via online teaching platforms is effective	4.33

agree” and 1 represents “Strongly disagree.” The findings are summarized in Table 8.

4.3.2 Survey on Online Teaching and Learning for Students

The survey for students was also divided into two parts. Part 1 (Q1–Q8) was designed with a 6-point scale, where 6 represents “Strongly agree” and 1 represents “Strongly disagree,” to reflect the general online teaching practice adopted by their teachers. The results are shown in Table 9.

Table 9 Individual question average for Q1 to Q8 (SCOM students)

Questions	SCOM
Q1. My teachers conducted live audio/video lectures smoothly via Microsoft Teams or other online teaching platforms (e.g., Zoom, Google Meet, etc.)	4.74
Q2. My teachers were well-prepared for online classes	4.79
Q3. My teachers shared their recorded audio/video lectures online after classes	4.09
Q4. My teachers taught using prerecorded audio/video lectures	4.21
Q5. My teachers engaged me in online live classroom discussions	4.55
Q6. My teachers held live online consultations after class for students	4.34
Q7. My teachers gave clear instructions/announcements on the arrangements for online teaching, assignments, projects, tests, etc	4.40
Q8. My teachers gave assignments/projects to improve my learning via online teaching platforms (e.g., Moodle)	4.61

Table 10 Individual question average for Q9 to Q18 (SCOM students)

Questions	SCOM
Q9. I attended my online classes according to the scheduled timetable	4.87
Q10. I listened to/watched the recorded audio/video lectures after class	4.62
Q11. I actively engaged in online live classroom discussions	4.46
Q12. I asked questions during online live audio/video lectures	4.30
Q13. I sought help from my teachers via live online consultations after class	4.35
Q14. I sought help from my teachers via other means after class	4.43
Q15. I received timely replies to my questions from my teachers in the consultations	4.66
Q16. I received useful feedback from my teachers on my graded assignments/projects	4.46
Q17. I was able to take quizzes/tests smoothly via online teaching platforms (e.g., Moodle)	4.34
Q18. Overall, I found that teaching and learning via online teaching platforms was effective	4.19

Part 2 (Q9–Q19) was designed to measure the students’ learning experiences with a 6-point scale, where 6 represents “Strongly agree” and 1 represents “Strongly disagree.” The findings are shown in Table 10.

5 Discussion

Online education is a process of communication that can be affected by communication noise. This study identified some major types of noise in online education, as perceived by teachers and students. Some interesting observations have been noted.

Physical noise Whereas teachers focused more on the problems and difficulties of online teaching platforms and emerging teaching modes such as mixed-mode and blended-mode teaching, students focused more on the distractions in their living environment. Students from mainland China experienced difficulties in accessing the teaching materials through VPNs and preferred recorded lectures for after-class reference. Both teachers and students agreed that IT training and tutorials were necessary.

Psychological noise In terms of psychological stress, teachers worried most about unexpected malfunctioning of the online platforms. Students felt pressured by live webcam requirements from their teachers and fatigued by long hours of learning with earphones on. Teachers felt frustrated about complaints from students regarding issues such as changes in assessment scales and online attendance policies, whereas students were vexed by free-riders in group projects. Students preferred teachers to upload recorded lectures, but some teachers were reluctant to do so out of worries about comments on sensitive issues being screenshotted and circulated on the Web. It is important for teachers and students to understand each other’s worries and sources of stress and to seek effective ways to overcome such psychological noise.

Semantic noise Both teachers and students regarded language problems as the main type of semantic noise. They agreed that using the students' native language as a medium of instruction during online teaching was more effective. Special terms and jargon also constituted sources of semantic noise that prevented students from decoding the content, especially without nonverbal cues and interaction from both sides. Recorded lectures and the use of whiteboard features were suggested as ways to reduce such semantic noise.

Effectiveness of online education All teachers who responded to the survey had conducted online classes according to the scheduled timetable, engaged students in online live classroom discussions, and given assignments/projects to improve students' learning via online teaching platforms. The majority of teachers who responded had shared recorded audio/video lectures online after class and held live online consultations for students after class. These results reflect the fact that teachers are capable of and confident in delivering lectures through online platforms and that the technical support from the university IT department was considered useful.

The students were generally satisfied with their teachers' online teaching performance. The rating for the question "My teachers were well-prepared for online classes" (4.79 out of a 6.0 point scale) was the highest among all items, indicating that the students appreciated their teachers' effort in conducting online classes.

The survey also revealed that the students had become accustomed to online learning and were generally satisfied with their online learning experience, as indicated by their score for the question "Overall, I found that teaching and learning via online teaching platforms was effective" (4.19) in Table 4. The three highest scores were assigned to "I attended my online classes according to the scheduled timetable" (4.87), "I listened to/watched the recorded audio/video lectures after class" (4.62), and "I actively engaged in online live classroom discussions" (4.46).

In general, the teachers were satisfied with their students' online learning performance. Interestingly, however, a large discrepancy was observed between students and teachers with regard to students' engagement in the online environment. The students' rating for "I actively engaged in online live classroom discussions" was as high as 4.46, whereas the teachers' rating for "My students actively engaged in online live classroom discussions" in Table 2 was only 3.33. According to the interpretation of some teachers' survey responses, the low score was probably due to the high expectations of some teachers who taught practical modules such as media production and multimedia design. These modules used to be conducted in the TV lab or computer lab with a very high level of student participation and engagement. The teachers presumably gave the level of student engagement in the online environment low scores because they were comparing it with the level of student engagement in face-to-face mode before the pandemic.

In sum, both teachers and students expressed their confidence in and satisfaction with online learning. They realized the existence of communication noise during the course of online education, and at the same time, they sought effective ways to overcome such communication noise.

6 Conclusions

This study approaches the challenges of e-learning in higher education during the pandemic from a communication noise perspective. The major types of communication noise identified from this study have practical implications for both teachers and students. A better understanding of the physical noise suffered by students, such as distraction by family members due to limited living space for local students, the lag-time and Internet connection problems for students from mainland China who have to use VPNs to access the teaching materials, and the hardship of wearing earphones for hours, will help teachers to find specific ways to reduce such noise.

In terms of psychological noise, teachers can try to ease students' stress concerning live webcam Q&As by adopting other means of communication with students. Students should also be aware of some teachers' reluctance and worries about uploading recorded lectures onto the Moodle system. Mutual agreement between teachers and students and better solutions can be reached.

Both teachers and students regard the choice of teaching language and special terminology as the main type of semantic noise, especially in the absence of nonverbal cues in online teaching. Recorded lectures, whiteboard features, and bilingual PowerPoint slides are examples of effective noise reduction methods. Such good practices can be beneficial for both online teachers and learners.

The survey results indicate that online teaching and learning have been adopted successfully and that the intended learning outcomes have essentially been achieved. Both teachers and students have made good attempts to adjust themselves to make online education possible and effective.

The COVID-19 pandemic will not last forever, but online learning is set to stay. A blend of online and in-person education modes is set to be the "new normal" in the wake of the COVID-19 pandemic. The identification of communication noise and effective noise reduction methods in e-learning is vital to both teachers and students during the pandemic and beyond.

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Learning Environment and Design

An Empirical Study on Peer Discussion About Statistical Evidence in Computing Laboratory



Ken W. Li and Marilyn Goos

Abstract To develop students' ability to justify or construct statistical evidence, students were placed into small groups in order to increase opportunities for peer discussions and social interactions in the classroom and beyond. An observation study was thus conducted to address the question of how peer discussion and student–teacher interaction would have a beneficial influence on learning the topic of statistical evidence. It was found that peer discussions allowed students to articulate their thoughts, enriched their thinking context, and broadened their thinking perspective when collaborating on inferential tasks. Sometimes, the students reached an impasse in a shared activity, so their teacher intervened in the learning activity to facilitate student discussions through free and open exchange of ideas in order to come up with a joint decision to solve statistical problems. After class, each group of the students successfully completed a practical project in which they showed cooperative engagement with inferential tasks and established joint understanding of statistical evidence through collaborative interaction.

Keywords Collaborative interaction · Regression Modelling · Scaffolding assistance · Statistical significance · Vocational education

1 Introduction

Arguments in weather forecasts, opinion polls, and so on are inductive. The arguments about the things that are about to happen around us are usually constructed through statistical inference. The topic of informal statistical inference is taught nowadays in preschool education (McPhee & Makar, 2018) as well as primary and

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secondary education (Doerr et al., 2017), while the topic of formal statistical inference is taught in vocational or undergraduate education. Both types of statistical inference aim to construct reasoned arguments on the basis of statistical evidence, either informally by reading data and finding data relationships, or through formal statistical inference that adopts a more scientific methodology as well as sophisticated statistical tools. Tobias-Lara and Gomez-Blancarte (2019) gave an account of the differences and similarities between these two types of statistical inference.

The topic of formal statistical inference in the present study was taught by the first author from elementary to advanced levels throughout the three years of the Higher Diploma in Applied Statistics and Computing (HDASC) course offered by a vocational education institution. The course aimed at equipping students with statistical knowledge and practical skills for statistical employment. In the first year of study, they learnt how to conduct statistical hypothesis testing by taking the steps of formulating statistical hypotheses; using proper statistical tools for conducting the testing; justifying whether or not to reject a null hypothesis, in turn deducing statistical evidence; and ultimately leading to a conclusion. Statistics modules like Regression Modelling taught in the second year focused on the integration of statistical inference and statistical methods. They were taught how to assess the fit of a regression model ($y = \beta_0 + \beta_1 x_1$); how to evaluate statistical significance of the regression intercept (β_0) as well as slope (β_1); and how to make use of the assessment results to generate statistical evidence in association with a claim about the model being feasible or infeasible for making predictions, thus needing to examine the role, strength, and representation of statistical evidence in Regression Modelling (Blume, 2017). In the final year of the study, statistical theories for underpinning the knowledge of statistical inference were taught in relation to how to develop inferential tools; how to detect or compute Types I and II errors arising from hypothesis testing; as well as how to make a trade-off between these two types of errors (see the assignment in Appendix).

Common flaws in students' inferential work were found, such as the wrong formulation of statistical hypotheses, incorrect inferential tools, unsound justification of statistical evidence as well as a mismatch between statistical significance and an argument or a conclusion (Li & Goos, 2013) because statistical inference is tedious and an intellectual activity involving much thinking as well as logical reasoning. For instance, some students were unaware that statistical evidence bearing on a conclusion was not definite because they did not understand the conclusion can only be based on a probabilistic view. That is, there is a chance they drew a wrong conclusion because no statistical tests could achieve 100% significant level. To avoid or rectify the flaws, students should be encouraged to articulate their thoughts, widening their thinking perspective through discussions or debates. This position is supported by Mercer (2004), Vygotsky (1978), and Zavershneva and van der Veer (2018), who argued that a language is a tool for communication and thinking. Students make their ideas available via communication to peers or their teacher. Language can be used for making thinking explicit so that peers and a teacher can read and respond. Students' minds would thus be broadened by appreciating others' verbal responses

and internalizing these as inner speech for directing or redirecting task progression or improvement. Hence, the classroom would be better organized to foster an environment facilitating discussion and social interaction.

2 Literature Review

Research studies, such as those conducted by Goos (2009) as well as Li and Goos (2017) provide us with some insights into sociocultural theories of mathematics and statistics learning. Goos argued that a community of inquiry was established in a mathematics classroom within an IT environment in which students communicated their own beliefs, ideas, and understanding, thus making different contributions and generating a more comprehensive view of learning contexts while the teacher played a role in facilitating learning and provided scaffolding assistance to students. Evidently, the cognitive contribution stemmed from peer collaboration and social interaction among students as well as between students and teacher. On the other hand, Li and Goos reported that the importance of learning partners, social interaction, collaborative learning, the significance of teacher's intervention, and teacher's scaffolding assistance were potential factors influencing social processes of statistics learning within an IT environment. Both studies are relevant to the theme of the present study but the latter report draws closer relevancy to the social context of statistics learning. Nevertheless, it does not give a detailed account of the organization of collaborative learning and the processes of promoting effective peer interaction in a statistics classroom, thus demanding an observational study to address the research question of what patterns of student–student and student–teacher talk are associated with articulation of thoughts about statistical evidence within an IT environment.

Students generally talk while attempting learning tasks collaboratively with their teacher and/or peers. To study the features, nature, and functions of classroom talk, concepts developed by Kumpulainen (1994), Mercer (1995), and Tharp and Gallimore (1995) can be adopted as an analysis framework. Talk among students would be classified by Mercer (1995) as exploratory, cumulative, or disputational. Exploratory talk is developed when students critically evaluate what they are told prior to accepting. Cumulative talk is characterized by students' positive responses without judging by what they are told. Disputational talk features as a peer's proposal being challenged based only on one's personal point of view.

Using Kumpulainen's framework, student talk can be further categorized into (a) intentional—giving gesture, action, voice or sound to express a wish to participate in discussion; (b) responsive—showing one's engagement with learning activities or expressing one's agreement to a lesser extent; (c) affectional—expressing one's personal feelings; (d) reproductional—repeating a peer's response or one's own response without elaboration; (e) experiential—sharing personal experience; (f) interrogative—seeking a peer's feedback when puzzling about their own work; (g) informative—offering facts or knowledge; (h) organizational—doing a tidy-up of ideas, wording or data; (i) compositional—deducing practical implications

for results; (j) imaginative—suggesting rough ideas without any grounds; (k) external thinking—articulating one’s thought when talking aloud; (l) judgemental—conveying one’s agreement or disagreement; (m) argumentational—challenging a peer’s proposal or defending one’s argument with evidence; (n) expository—discovering things that are unfamiliar or unanticipated without detailed planning; (o) heuristic—formulating or regulating strategies; and (p) hypothetical—proposing ideas without elaboration. The first six functions, (a)–(f) are social in nature for initiating and maintaining active communication; the middle four functions, (g)–(j) are mainly for attempting low-collaborative tasks; and the last six functions, (k)–(p) are to promote higher-order thinking through social processes of collective argumentation as described by Brown (2005) as well by Panselinas and Komis (2009).

On the other hand, the talk between students and teacher serves: to elicit knowledge from students; to respond to what students said; and to recap significant ideas or important keywords mentioned by students (Mercer, 1995). Teacher–student talk also serves the purpose of assisting students’ performance via these discourse categories: modelling, questioning, cognitive structuring, contingency management, feedback, and instruction (Tharp & Gallimore, 1995). Within each of these discourse categories, the teacher may elicit, respond, or recap. For instance, questioning can be used to elicit what students already know or how their understanding develops or misunderstanding arises. Alternatively, questioning is used for responding to students if the teacher wishes to extend discussions. Questioning may also be used to offer directions towards task improvement or accomplishment after recapping students’ useful ideas as hints.

3 Teaching and Learning

To study how peer discussion plays a significant role in statistics teaching and learning within the framework of sociocultural theories of learning, the HDASC Year 2 students (aged 19–22) taking the module on Regression Modelling were divided into small groups in order to increase peer learning and social interaction. They were encouraged to work collaboratively in the classroom and beyond, except in a midterm test and a final examination. They naturally sat together or near each other when attending a class held in a lecture theatre; they collaborated on the worksheets in a practice session conducted in a statistical computing laboratory each week for thirteen weeks. Both the lecture theatre and the laboratory were equipped with computer hardware as well as software, a data projector, microphones, and loudspeakers. All PowerPoint handouts and Excel work were displayed on a projection screen synchronizing with the teacher’s talk and verbal and non-verbal cues, for example, using a mouse pointer to draw his students’ attention to key areas in Excel programming syntax and results. Instead of delivering lectures, their teacher led class discussions towards developing an understanding of regression topics with practical application using Excel tools.

After the teacher briefly chatted with students in a welcoming tone at the beginning of each lecture, the students went back to the previous handouts while the teacher was reiterating key concepts from earlier topics. This was because the twelve topics in the module were interconnected in the Regression Modelling workflow. In the lecture associated with the present context, students were taught how to conduct statistical hypothesis testing about the significance of model fitting as well as the regression parameters, β_0 and β_1 using Excel; how to establish statistical evidence using the test results; as well as how to construct and report reasoned arguments on the basis of the statistical evidence. The teacher initiated discussions inviting all the students to respond. They talked about how they addressed a question of common concern based on their own understandings, opinions, judgements, or perspectives. The discussion they held was similar to collective argumentation or a form of interaction where they joined together to evaluate ideas their classmates brought forward in order to come up with a joint decision leading to a correct and complete answer.

At the beginning of a practice session, the teacher then recapped the concepts of statistical inference and briefly discussed the source, context, and contents of data, and relevant statistical tools on the worksheet he assigned to the students. Each group of the students attempted the learning tasks which were designed to promote an exchange of views, sharing of knowledge, and resolution of problems in order to cultivate a higher level of involvement within a group.

To prepare the students for their prospective statistical careers, the teacher asked students to complete a project on a group basis by the end of the module so as to achieve three educational objectives. First, the project provided opportunities to foster teamwork and cooperative working skills which are essential for the statistics workplace. Second, there is also a need for a project in which students can appreciate the relevance and practical use of Regression Modelling in which they interconnect between statistical concepts; make connections between inferential tools and statistical evidence; construct a Regression Model using the evidence; link the model and the practical context; organize and integrate all of these into a comprehensive report addressing whom it may concern, but, if infeasible, they should use the evidence to substantiate the allegations against model construction. Third, project work was also grounded on sociocultural theories of learning as promoting social interaction among students and enabling verbal exchanges between students to clarify misunderstandings, accomplish tasks, and solve regression problems outside the classroom. Each group could choose one of these themes of study: traffic and public transport, manpower resources, weather, water consumption, retail business, and import and export trades, together with a set of official and relevant data consisting of a dependent variable (y) and three independent variables (x_1, x_2, x_3). The projects were assessed according to the extent to which the students had: (i) scrutinized data; (ii) formulated hypotheses; (iii) utilized inferential tools by means of statistical methods; (iv) evaluated the inferential force of evidence; and (v) constructed reasoned arguments. The first assessment criterion about valuing appropriate and reliable data which would set out the lay of the land of evidence in an inferential process is important (Schum, 2001), while the last four assessment criteria are consistent with the recommendations of Tobias-Lara and Gomez-Blancarte (2019). It is also of great importance in

assessing how the students present logical lines of reasoning in verbal and written modes when making links among concepts, inferential results, and evidence because both modes are essential for communication in the statistics workplace and to display one's thought process.

The projects after assessment were returned to students together with written feedback on their strengths, weaknesses, merits, and/or demerits. The weaknesses or demerits were valuable information about which areas the students should give more attention for improvement and the teacher ought to focus on for instructional scaffolding. In the project reports, many students stated the objectives and fulfilled assessment criteria (i)–(v). Specifically, they constructed credible lines of reasoning about the model building and reported the practical significance and usage of the model together with interpretations of the significant regression intercept (β_0) and slope (β_1).

The students were offered an opportunity to defend and/or clarify the project work in an oral presentation within thirty minutes in the practice session, as enabling each individual student to illustrate his or her own thought process. They went through all the stages in a Regression Modelling process: formulation of project objectives, examination of data, construction as well as validation of a model, and practical implications of the model, mostly together with sound justification and/or statistical evidence. The oral presentations were consistent with their written reports which were mostly elucidative. Their classmates were attentive to the presentation but nobody challenged their work. Only the teacher initiated discussions to promote thinking and reasoning. Statistical evidence was the common thing most students skipped or missed in the point of the argument they wanted to make, and so the teacher asked them to substantiate the argument after eliciting a key phrase in the argument or relevant results to hint at assembling both for the cohesive structure in evidence. If students still could not give a complete answer, the teacher probed for the rationale behind the conclusions after recapping and consolidating their keywords.

4 Observation Study

A study was conducted for observing how peer collaboration might be beneficial to student learning associated with the establishment of statistical evidence. Peer conversation was audiotaped when students were keying in data; programming Excel; reading the screen displays of computer output; and presenting their work on their laboratory worksheets. The students' conversations were transcribed in full, with relevant excerpts being selected for analysis.

In the practice session, the students were given official statistics with a set of social welfare data consisting of a dependent variable (y) and two independent variables (x_1, x_2). They worked collaboratively on computers to attempt four inferential tasks in Regression Modelling. The first task was to fit two regression models to the given data, namely $y = \beta_0 + \beta_1 x_1$ and $y = \beta_0 + \beta_2 x_2$ using Excel tools. The second and third tasks demanded an evaluation of the significance of the regression intercept

(β_0) and slope (β_1), respectively, in each of the two models using the inferential tool, statistical hypothesis testing. The evaluation task is about examining the strength of statistical evidence. The fourth task following the previous two tasks was to report a mathematical relationship between a dependent variable and an independent variable for each of the two models that would make sense after β_0 and/or (β_1) had achieved statistical significance.

Interactions between three students (with codes, J, K, and L to remain anonymous) are analysed to illustrate the effects of peer collaboration. L and K had already formed a group, and J joined because her fellow group member was absent from the practice session. The conversation of only this group of three students was available for analysis for two reasons. First, few students agreed to voluntarily participate in the observation study. Second, the microphones for audiotaping were placed at a distance from those who did agree to participate so as not to disturb them from doing their work; however, some still tended to talk less frequently and less audibly because of being anxious about having their conversations audiotaped. Thus, despite following all ethical processes for conducting the research, only one group's audio-recording was available for analysis.

Prior to attempting the tasks, students judged whether the data were relevant and credible as well as whether the measurement and measurement units of the data covered a reasonable and meaningful range. This judgement takes precedence over any statistical methods to avoid discrediting inferential results (Schum, 2001). They accomplished the first task efficiently because they had become proficient at building Regression Models after attending lectures and accomplishing similar tasks in the previous few practice sessions. Shortly after, they read the Excel output in which they checked regression estimates of β_0 and β_1 , together with significance testing results so as to attempt the second and third tasks. They had trouble with grading the strength of statistical evidence because they could not distinguish between two available approaches to evaluating statistical evidence. The first approach is to compare the test statistic with the critical value at a pre-specified level of significance in order to decide whether or not to reject H_0 (a null hypothesis). Another approach deals with checking whether or not the decision substantiates or forms persuasive lines of reasoning based on the p-value which reports the chance of committing a Type I error; i.e., the p-value needs not fix a certain level of significance (α) but evaluates how likely it is that a true hypothesis would be rejected. Both approaches are equivalent to a certain extent in testing of statistical hypotheses. The first approach is relatively simple and straightforward but the second approach is relatively more objective. Kumpulainen's (1994) and Mercer's (1995) frameworks were used to analyse the nature and contents of talk among students (Tables 1–4) when they moved on to selecting and making use of an appropriate statistical tool.

Both students, L and K were oblivious of what output was produced by the Regression Analysis tool in Excel. Their queries were concerned with the proper selection of a statistical tool, the test statistic versus p-value. L's talk was interrogative, characterized by seeking her peers' approval for the use of the p-value because L was concerned about instances in which they attempted to evaluate the extent to which H_0 would be rejected or not. J's response simply agreed with L's proposal, as believing

Table 1 The nature and contents of talk among students, J, K, and L when selecting an appropriate statistical tool

Excerpt	Student code	Contents of talk
1	L:	Do we just look at the p-value? (Interrogative)
2	J:	Yes (Responsive)
3	L:	We are going to use Excel (Responsive)
4	K:	Are we allowed to use p-value? (Interrogative) Does the teacher ask us to compute? (Interrogative)
5	J:	The teacher doesn't want us to compute but directly make use of p-value (Responsive)

the p-value is a proper tool, then L's subsequent responsive talk sidetracked the issue and proposed to use Excel. Meanwhile, K was puzzled, so K's interrogative query brought her peers back to the question of using the p-value and raised another question of whether to compute the test statistics and compare with α . J clarified by recalling the teacher's recommendation and she also suggested making use of the p-value resulting from Excel output without the need for computing. The recommendation about the widely adopted tool, p-value for justifying statistical evidence in hypothesis testing was briefed at the beginning of the practice session. According to Mercer (1995), the above excerpts can be categorized as cumulative because their talk merely exhibited a simple question-and-answer form focusing on the selection of statistical evidence to reject or not to reject H_0 , but without involving critical evaluation or tool justification. The students eventually made use of the p-value to grade the extent to which H_0 would be rejected (Table 1).

Student K recalled the statistical logic that is critical for evaluating H_0 in deciding whether or not a regression parameter, β_0 or β_1 was statistically significantly different from zero. She checked the Excel output and found the p-value was smaller than α and immediately announced, "*A smaller p-value indicates to reject H_0 . That should be the case*", implying rejection of H_0 . Her utterance (Excerpt 6) displayed external thinking. J's talk seemed argumentational in proposing to use another statistical tool, the t-statistic (i.e. the value resulting from the test statistic), and outlined the rejection criterion for H_0 in which she mixed up p-value, α , and t-statistic. L responded by attempting to rectify J's mistakes, but did so neither completely nor exhaustively (Excerpt 8). K insisted on using the p-value as a rejection criterion and recalled rejection and non-rejection criteria of H_0 thoroughly before deciding to reject or not to reject H_0 (Excerpt 9). Her utterance was therefore informative. There was no more negotiation about the rejection criterion and they eventually agreed to use the p-value (see Table 2).

Using Mercer's (1995) framework to analyse the above excerpts, the talk was probably exploratory although they did not negotiate much about the rejection criterion. In fact, they did not totally accept their peer's proposals but evaluated their own ideas critically and also raised counter-proposals.

Table 2 The nature and contents of talk among students, J, K, and L when checking the criteria for rejecting H_0

Excerpt	Student code	Contents of talk
6	K:	p-value is larger, ... A smaller p-value indicates to reject H_0 . That should be the case (External thinking)
7	J:	If t(-statistic) is larger than α , ... p-value? (Argumentational)
8	L:	(p-value is) smaller (than α means to reject H_0) (Responsive)
9	K:	(If p-value is) smaller (than α , that) is to reject (H_0), larger (than α) is to accept (H_0); (or say) not to reject (H_0). It is very confusing (Informative)

While checking the p-value resulting from a statistical test, J did not understand the p-value being presented using scientific notation and asked, “*E?*” *I don’t know what E is?*”, so her talk was an interrogative enquiry about the mathematical notation. L replied that *E* represented exponential notation, using external thinking. They all subsequently could read the p-value resulting from the statistical test and their talk was expository when announcing a small p-value (Excerpts 12, 13, and 16). A small p-value here concerns the level of statistical significance for which we would reject H_0 . Specifically, J pointed out that the p-value is 10 to the power negative twelve (i.e., ... $\times 10^{-12}$) (Excerpt 17). J and K decided to reject H_0 , thus forming a basis for a valid statement, a probable conclusion, or an inductive argument (Excerpts 14 and 15). All these three excerpts represent external thinking involving articulation of thought.

This part of peer talk (Table 3) is related to reading a statistical result from a screen display of Excel outputs as being visible products of problem-solving from students’ joint effort (Mercer 2005). Statistical results output from Excel initiated processes of thought and action in a physical form shared in their collaborative work. Their utterances are classified as exploratory according to Mercer (1995) because

Table 3 The nature and contents of talk among students, J, K, and L when grading the strength of statistical evidence

Excerpt	Student code	Contents of talk
10	J:	E ? I don’t know what E (in the p-value) is? (Interrogative)
11	L:	E represents exponential (External thinking)
12	K:	This is very small (Expositional)
13	J:	This is very small (Expositional)
14	K:	That is to reject (H_0) (External thinking)
15	J:	Reject (H_0) (External thinking)
16	L:	(4E-12 is) so small! (Expositional)
17	J:	This E(-12) is 10 to power negative twelve (External thinking)

Table 4 Functions of talk displayed by the three students

Function of talk	Frequency		
	Student J	Student K	Student L
Interrogative	1	1	1
Responsive	2		2
External thinking	2	2	1
Argumentational	1		
Informative		1	
Expositional	1	1	1
Overall	7	5	5

they all critically evaluated the p-value in connection with H_0 individually and J and K concluded to reject H_0 .

All the students were engaged with peer discussion (Tables 1, 2 and 3) in which the question and answer exchanges shaped the flow of inferential tasks on which they worked. Table 4 summarizes various functions of talk displayed by them in order to generate a more comprehensive view of thinking when attempting the learning tasks together. The patterns of talk displayed by the three students, J, K, and L were similar; much of their talk was external thinking, argumentational, and expositional in nature for examining the strength of statistical evidence using higher-order thinking. Some of their talk had the purpose of expressing agreement to a lesser extent when selecting the tool for checking statistical evidence, and only one instance was for attempting a low-collaborative task as in summarizing the criteria of H_0 rejection.

When the students were struggling to understand the scientific notation of the p-value, the teacher intervened and elicited J's response, " 4×10^{-12} ". He then modelled for them how to read an extremely small p-value in scientific notation that is equivalent to a very low probability of H_0 being true. To progress in model building requires a decision criterion of whether or not to reject H_0 at a given level of statistical significance, α . The teacher also modelled the selection of the level of significance, 5% that is commonly adopted as an acceptable level of Type I error in statistical inference because it entails a rational weighing of the evidence; otherwise, using a higher level of statistical significance would diminish the credibility of the evidence. The teacher further modelled the physical act of searching for the p-value that would be used as statistical evidence when contrasting with α . J's response in Excerpt 27 affirmed the rejection of H_0 . The dialogue between the students and teacher displayed verbal exchanges. The teacher elicited their written as well as verbal responses, which they supplemented after the teacher had recapped their incomplete responses. Modelling assistance was offered successfully to associate with the level of statistical significance and extend their discussion (refer to Table 5).

A decision in favour or not in favour of rejection of H_0 yielded opposite implications for the significance of a regression parameter, β_0 or β_1 as well as the regression model being built. For this reason, the teacher checked how the students formulated H_0 in association with the role and representation of statistical evidence. Student

Table 5 The contents of talk between the teacher and students, J, K, and L when reporting and grading the strength of statistical evidence

Excerpt	Teacher and Student code	Contents of talk
18	Teacher:	Yes, you can just write it down, 0.0000 because you have a value 4×10^{-12} which is zero point ... and then we have ...
19	J:	Twelve zeros
20	Teacher:	Twelve zeros ... and then we have 4. So, if we look at four decimal places which are similar to 0.0000 (after truncation). Understand what I mean? Because we compare with 0.0 ...
21	J:	5
22	Teacher:	5 so obviously this (p-) value is much ...
23	J & K:	Smaller
24	Teacher:	Smaller? or larger?
25	J & K:	Smaller
26	Teacher:	$(4 \times 10^{-12}$ is) much smaller than 0.05, so we reject H_0
27	J:	Yes!

J gave a quick but incorrect response due to misinterpreting the teacher’s question rather than making any conceptual error. Her instantaneous response, “*Sorry! Sorry!*” indicated immediate self-awareness of her mistakes as not being approved by her verbal thought. While she was attempting to correct her H_0 formulation, L interjected, “ $H_0: \beta_o = 0$ ” and her prompt H_0 reformulation was much quicker than the teacher’s correction. The teacher recapped L’s correct answer to reinforce the concept of H_0 . The three students, J, K, and L were laughing and their laugh was sincere as their stress at getting the correct H_0 formulation was being released. The teacher attempted to extend discussion of the formulation of H_1 (alternative hypothesis), without success (Excerpt 32). However, his modelling of the formulation of H_1 allowed J to respond to the cue, “ $H_1: \beta_o \neq 0$ ”. He then gave feedback to validate her correct answer (Table 6).

The teacher initially offered the three students, J, K, and L cognitive structuring assistance by providing explanatory structures for justifying the rejection decision based on the p-value. They were confused about deducing the implication of rejecting H_0 so the teacher asked, “*What does it mean? ... We reject H_0 by looking at two different values (p-value and α -value)?*” They found the question vague, so the teacher rephrased the question more as a statement, “*Does it mean this small (p-) value is in the rejection region, isn’t it?*” J replied, “*Yes!*” To reinforce the concept of rejecting H_0 the students already held, the teacher modelled drawing a conclusion from the statistical evidence when contrasting between the areas corresponding to the p-value and α . The teacher found they could gradually pick up the responsibility for the tasks so he then left them alone to draw a conclusion that was their resulting belief in the falsehood of H_0 . The conclusion based upon probabilistic

Table 6 The contents of talk between the teacher and students, J, K, and L when formulating H_0 and H_1

Excerpt	Teacher and student code	Contents of talk
28	Teacher:	What is H_0 in this case?
29	J:	H_0 is 0.05. Sorry! Sorry! <i>(While J was saying "Sorry!" L shouted, $H_0: \beta_0 = 0$. Both students admired L's answer and said, "Very good!")</i>
30	Teacher:	$H_0: \beta_0 = 0$ <i>(The three students were laughing.)</i> H_1 ... What is H_1 ?
31	J:	H_1 is ...
32	Teacher:	$H_1: \beta_0 \neq \dots$
33	J:	$H_1: \beta_0 \neq 0$
34	Teacher:	Not equal 0, yes! OK?

belief is not completely credible (Schum, 2001). The students were actively engaged in discussion in which the teacher played key roles of orchestrating social interaction between students; facilitating student discussion; and offering direction towards deeper thinking (Table 7).

Table 7 The contents of talk between the teacher and students, J, K, and L when discussing two approaches to evaluating statistical evidence

Excerpt	Teacher and student code	Contents of talk
35	Teacher:	So, if a very small (p-)value, much smaller than 0.05, we can reject H_0
36	J, K & L:	Hm!
37	Teacher:	What does it mean? We reject H_0 by looking at two different values (p-value and α -value)? Does it mean this small (p-)value is in the rejection region, isn't it?
38	J:	Yes!
39	Teacher:	This (p-value) is very small because the rejection region is larger than the (p-)value ... <i>(The teacher pointed at the p-value displayed on their computer monitor.)</i>
40	J:	The (p-)value
41	Teacher:	We have obtained, OK?
42	J:	I see! <i>(The teacher left them alone to draw a conclusion.)</i>

The students continued to work together without further intervention from the teacher. They successfully completed the last task by reporting a mathematical relationship between a dependent variable and an independent variable for each of the two models they had built.

Apart from collaboratively accomplishing inferential tasks in the statistical computing laboratory, students L and K also submitted their project report for assessment; student J did not do so because J was in another project team. In the report, both L and K spelt out the objectives of their project; made judicious use of the data available to them by means of descriptive statistics and statistical graphing as convincing arguments are built on the relevant, reliable, and valid data (Schum, 2001) free of bias (Shield, 2000). They utilized graphical and computational tools to establish sound evidence in model building. They had an incorrect suspicion of outlying observations, which in fact did not exist, so neither regression problems were created nor the model fitting was distorted. In model validation, they verified the linearity, homoscedasticity, independence, and normality of the data. They elaborated the practical usage of the model and the meaning of the regression estimates of β_0 and β_1 relating to the context and measurement units of data. A conclusion on the practical significance of the model for making predictions was made. More importantly, the lexical content in the report showed logical flow, thinking, and reasoning.

In the project presentation, student L gave an introduction; clearly stated the project objectives; confirmed the source of data (i.e., y , x_1 , x_2 , x_3) was reliable and the data content was relevant; checked the measurements of the data were meaningful and unbiased by utilizing the measures of central tendency as tools. She proposed to build three Regression Models for making predictions of y from x_1 , x_2 , and x_3 on the grounds that scatterplots exhibited a linear relationship between y and x_1 ; y and x_2 ; and also y and x_3 and she further substantiated the relationship using the correlation coefficient. Among the three models, she suggested using the model with the largest correlation coefficient. Her peer, K took turns in justifying and comparing the model fitting among the three models using R^2 (the coefficient of determination indicating the goodness of fit of a model) and decided to choose the model with the largest R^2 and further illustrated the best model fitting using a graph of y against both observed and predicted values of x . The model was affirmed by verifying the regression assumptions and non-existence of outlying or influential observations. Furthermore, she showed that the Regression Model as well as the intercept (β_0) and slope (β_1) of the model were significant together with statistical evidence; gave a practical interpretation of both estimates of β_0 and β_1 ; and ultimately concluded that the model was feasible for making predictions in connection with the data context. Both students gave a clear verbal presentation of the modelling workflow without any interruption and utilized statistical evidence to defend the model they had built. Each of them played a significant role and gave contributions to the project work.

Nevertheless, the teacher posed questions to probe the students' construction of logical lines of reasoning on statistical evidence. L was attentive to the first question but gave ambiguous responses, so the question relating to the notion of Regression Modelling of the relationship between y and x was raised by the teacher after giving a cued elicitation, i.e. the correlation coefficient presented by the students. L could not

directly answer the question but highlighted correlation concepts. After the teacher had rephrased his question directing her towards the data context of y and x , she managed to give a complete answer. Another question was raised to justify the model fitting based on the graph, and K attempted to answer but was incomplete. L gave her some help and asked the teacher to elaborate on the question. She gave responses without directly addressing the question. Teacher questioning continued and two hints were given. One was about decoding observed and predicted values of x on the graph and the other was about drawing comparisons between these two values. She followed the hints to construct an explicit argument in defence of the model fitting. Both students worked in close collaboration on the project, shared the workload, and offered mutual assistance. The content of verbal exchanges between the students and teacher has a rich thinking context.

5 Conclusion

Evidence deriving from statistical results is by no means perfect, owing to some degree of uncertainty; the credibility of statements, arguments, or conclusions based on the evidence may be challenged from various perspectives. To ascertain credibility, it would be necessary to avoid personal bias by having input from more people embracing a broader view of thinking to form intellectual resources for sharing such that lines of reasoning can be constructed or revised exhaustively. This present study shows the cohesive structure of discussion that develops conceptual understanding of statistical evidence, mostly by examining the role, strength, and representation of statistical evidence (Blume, 2017). Specifically, cumulative talk was delineated by the pattern of simple responses given to interrogative enquiry about tool selection. Exploratory talk was observed when involving articulation of thinking and discovering the extraordinarily small p -value using external thinking, followed by expositional speech. Both patterns were evident from verbal exchanges among the students; with the second pattern displaying higher-order thinking. Exploratory talk was necessary for them to critically evaluate the p -value in connection with H_0 using verbal expositions: external thinking, along with argumentational, responsive, and informative talk. Irrespective of the types of talk they used, the group of students gained from collaboration and subsequently generated a more comprehensive view of thinking so as to complete a statistical inference.

However, statistical inference required thinking and reasoning that sometimes could not be developed only through peer discussion and joint performance of tasks in the absence of the teacher. The teacher therefore regularly intervened to check students' learning progress, promote intellectual exchanges between them, and offer them learning assistance via modelling, cognitive structuring, and feedback. Modelling assistance was offered to stimulate students' thinking and provided direction in advancing the level of their thinking in association with the tasks of formulating the null and alternative hypotheses; selecting the level of statistical significance; constructing statistical evidence; and drawing conclusions from the

evidence. The teacher elicited knowledge from the students and recapped their incomplete verbal responses, but also offered useful and important modelling assistance. Cognitive structuring was adopted to organize students' thinking associated with the inferential tasks of justifying the rejection decision based on the p-value. The teacher gave feedback to validate students' correct responses. A similar approach to assisting students in achieving specific learning objectives was evident from students' oral project presentations.

The findings of these analyses of talk in a statistics classroom and beyond are grounded in sociocultural theories of learning and revealed how peer discussion structured thought in the context of statistical evidence. However, conclusions are only tentative since not all students in the class volunteered to participate in the observational component of the study (whereas all agreed to participate in the questionnaire-based survey and experimental study components). Among the student volunteers, some appeared to be anxious at the prospect of having their conversations audio-recorded, and as a result, talked less frequently and less audibly. Hence, the conversation of only one group of three students was available for analysis; however, based on the teacher's knowledge of this class, it is assured that they are representative of the kind of talk observed throughout the observation period.

Appendix

The following is a problem scenario in the Statistical Inference assignment in HDASC Year 3.

A random sample of 30 shoppers will be chosen in a supermarket to try a new flavour of ice-cream. They will be asked whether they like it or not. The marketing department of a dairy products company wants to know whether the new flavour of ice-cream will have a successful launch based on this market testing. Let p denote the proportion of shoppers who like the new flavour and let the test statistic X represent the number of shoppers who like the new flavour. Suppose that you are a statistical officer assigned to this project.

Complete the following tasks:

- (i) For a successful launch, at least half of the shoppers should like the new flavour. State H_0 and H_1 about p .
- (ii) Determine the value of the Type I error when $X \leq 15$ is chosen as the rejection region.
- (iii) Determine the value of the Type II error when $p = 0.4$ represents the true proportion of shoppers who like the new flavour.
- (iv) Use Microsoft Excel to complete the following;
 - (a) design and implement a spreadsheet that can calculate the values of the Type I and Type II errors for different rejection regions and

- (b) construct **ONE** chart for a comparison of the values of the Type I and Type II errors resulting from the spreadsheet you gave as your answer to (iv)(a).
- (xxii) Based on the chart you gave as your answer to (iv)(b), describe briefly the relationships between:
- the Type I error and the test statistics and
 - the Type II error and the test statistics.
- (vi) Based on the chart you gave as your answer to (iv)(b), determine the best rejection region to be used for hypothesis testing for the company, giving reasons for your answer.

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Effective Learning Through Project-Based Learning: Collaboration, Community, Design, and Technology



Will W. K. Ma

Abstract Project-based learning assists students in several ways. It gives students greater control and flexibility to prepare and engage more in their learning. It integrates cooperation with industry or professional communities to build real-life issues to provide students with authentic learning experience. Project-based learning has been very popular in higher education. However, there appeared to be a gap in past studies in that they defined PBL differently and so developed PBL from a limited perspective. This research aims to explore current project-based learning studies in higher education to explore their learning advantages, implementation design, and technology support. In the last two decades, a search for project-based learning yielded 698 publications. Following a focus on higher education and the removal of irrelevant articles, 142 articles published between 2003 and 2019 were chosen for further research. The studies' abstract was analyzed, yielding four key themes: collaboration, community, design, and technology. These themes are further addressed regarding learning processes. Implications and further studies have been discussed.

Keywords Project-based learning · Pedagogy · Collaboration · Community · Curriculum design · Technology

1 Introduction

1.1 What is Project-Based Learning?

Project-based learning (PBL) requires the incorporation of various stakeholders into the curriculum so that learners are actively engaged in the process of establishing connections with the experiences of others (e.g., Haydari & Kara, 2015).

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Project-based learning promotes independent study through involvement in initiatives, although some still rely heavily on direct education as the key source of knowledge (García-Aracil, 2012). Earl et al. (2018) address, under Dewey’s behavioral change theory, educational interactions focused on pattern disruption and real-world learning contribute to innovation in the creation of new behaviors. It presents a series of reflections by instructors and participants on the relationship of the program to the core themes of habit, disruption, creative action, and dialog within the five components of adaptive education: stakeholders, real-world learning, off-campus, transdisciplinarity, and non-traditional rewards. Adaptive education builds potential for future sustainability leaders and educators. Project-based learning has the benefit of promoting a more inclusive approach to education, in particular “by increasing student control over learning” (Harmer & Stokes, 2016, p. 531) and real learning experience in “distributed and decentralized working environments” (Lahiff & Guile, 2016, p. 302). It promotes educational aspirations, enthusiasm, and attainment through involvement (Johnson & Lewis, 2013).

The below table summarizes the various learning advantages, process design, and distinct features (see Table 1).

Table 1 Selected works on distinct features of project-based learning

Distinct features	Studies
Better learning achievement: <i>PBL aims to increase the overall performance of students and their satisfaction with the course</i>	E.g., Chipere (2017), García-Aracil (2012), Mariage and Garmon (2003)
Engaged and deeper learning: <i>PBL facilitates committed learning and as an effective resource to improve meaningful learning and to increase their commitment to learning</i>	E.g., Fernandes et al. (2014), Smallwood and Brunner (2017), Wilson and Fowler (2005)
Professional skills: <i>PBL effectively provides the appropriate skills to future professionals according to market demands</i>	E.g., Llorens et al. (2017), Rand (2016), Tinnirello et al. (2010)
Industrial and professional partnership for authentic learning experience: <i>PBL designs involve the collaboration of student, university, and employer representatives that authentic experience of PBL encourages students to relate their teaching activities</i>	E.g., Diamond et al. (2011), Hanney (2018), Wilson et al. (2016)
Service-learning in Real-world Situation: <i>PBL promotes students to adapt theory to real-world circumstances and to apply them to their service-learning that helps to alleviate student anxiety and uncertainty about theory application and service-learning</i>	E.g., Gerstenblatt and Gilbert (2014), Ricke (2018)

1.2 Research Questions

However, previous studies appeared to have a gap in that they defined PBL differently and hence created PBL from a narrow perspective. As a result, the purpose of this study was to investigate current project-based learning studies in higher education to examine their learning benefits, implementation design, and technological support in order to establish a comprehensive framework in project-based learning. The following research questions were addressed in this study:

- RQ1: What is a project-based learning study in higher education?
- RQ2: What are the typical enablers for the design and implementation of project-based learning?
- RQ3: What are the common themes in project-based learning studies?

2 Methods

2.1 Background

This study analyzed previous empirical research to examine project-based learning. The analysis is limited to higher education studies which have documented empirical findings on the design and implementation of project-based learning. Learners can be undergraduate and master's graduates, teachers, and community professionals in professional development.

2.2 Data and Sample

One way to understand the recent work that has been done on project-based learning is to study previous research studies on the topic. Important sources include empiric studies that review the literature, gather opinions of human subjects, or observe the behavior of human subjects in relation to project-based learning. Papers documenting such studies usually include a literature review to identify relevant constructs, a description of the study designs used, a summary of the techniques used to gather empirical data, and an overview of the findings and conclusions of the data. Therefore, each of these studies provides us with a deeper understanding of project-based learning. An analysis of these empirical studies will help address our research questions.

Table 2 Search process and results of project-based learning studies from the e-database *Academic Search Complete*

Steps	Keywords	Duration	Articles
1	“Project-based Learning”	1988–2019	698
2	AND Subject term, “education”	1988–2019	463
3	Remove irrelevant studies	2003–2019	142

N.B. The scope of the search was limited to the abstract field. Limiters included: *Scholarly (Peer Reviewed) Journals*; *Research Article* document type; and *English language*

2.3 Data Collection

The data for this research were empirical findings on project-based learning aiming at defining effective learning and teaching. Such studies were found using the *Academic Search Complete* online database, which includes the full text of more than 5,900 publications in various disciplines, including the full text of more than 5,030 peer-reviewed titles. The contents of this database go back to 1887. A description of the search process is shown in the table below (see Table 2). From the 463 studies, each was reviewed one by one. Irrelevant studies of higher education project-based learning were removed, for example, book reviews and meta-analysis were removed; specific disciplines research reports not related to PBL were removed, and so on. Finally, 142 studies have been included for further analysis.

2.4 Data Analysis

All 142 abstracts were inductively analyzed using NVivo 12.0 (Bazeley, 2002) to classify main topics and concepts in line with qualitative textual and content review procedures (e.g., Neuman, 2006; Punch, 1998). The research generated lists and word clouds showing the most commonly used words, concepts, and phrases. The initial stage of open coding concentrated on the definition of key terms; afterwards, further analysis attempted to organize words and concepts into groups (e.g., Glaser & Strauss, 1967; Glaser, 1978). The results were derived from a combination of inductive and deductive reasoning. For example, terms were grouped inductively, where possible, on the basis of synonym grouping and derivative words in abstracts.

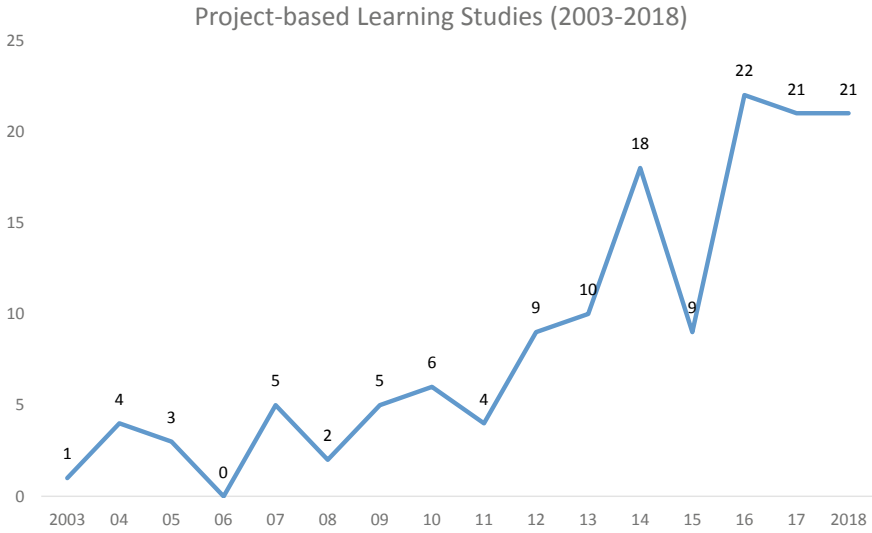


Fig. 1 Year versus number of studies on project-based learning

3 Results

3.1 Year and Number of Studies

Between 2003 and 2019, 142 articles appeared in 81 peer-reviewed academic journals. There has been a progressively growing pattern of studies since 2003 when the first applicable study on project-based learning emerged (see Fig. 1).

3.2 Journal and Year of Publications

The journal publications and the year of publications were analyzed, and 81 publication journals were identified. The highest count was from European Journal of Engineering Education which had 11 studies published. The second was from Innovations in Education and Teaching International which had 7. The third was from Assessment and Evaluation in Higher Education; Interactive Learning Environments; Journal of Geography in Higher Education, they all had 5 studies published. For the remaining others, there were 1–4 studies published (see Table 3).

Table 3 Five or more appearances of PBL studies on journal publications (2003–2019)

Publications	Studies	Year
European Journal of Engineering Education	11	2014 (×3), 2015, 2016, 2017 (×4), 2018 (×2)
Innovations in Education & Teaching International	7	2011, 2012, 2014, 2015 (×2), 2016, 2017
Interactive Learning Environments	6	2012, 2014 (×2), 2016, 2018
Assessment & Evaluation in Higher Education	5	2004, 2005, 2016 (×2), 2018
Teaching in Higher Education	5	2014, 2016, 2017, 2018 (×2)

Table 4 Appearances of discipline keywords in the studies

Disciplines	Count
Engineering, Science	68
Language	31
Management	20
Health	15

Note Education was not included in the table

3.3 Subject Disciplines

Most project-based learning initiatives have been incorporated in interdisciplinary project designs. Nevertheless, the PBL has also been developed and implemented for different disciplines (see Table 4).

3.4 Instrument Development: Keywords and Themes

NVivo 12.0 was used to run a word frequency test with stemmed terms to produce both an exact word count list and a word cloud (see Fig. 2).

NVivo 12.0 was used to preliminary analyze the studies using the theme auto-code function. The resulting auto-code themes were reviewed one by one with respect to the meaning and context, in order to remove and combine repeating themes, to create themes not appeared in the auto-code, to rearrange keywords to the corresponding themes, and so on. Finally, four primary concepts emerged from the keywords concerned, relating to three facets of project-based learning: *collaboration, community, design, and technology* (see Table 5).

4 Collaboration

4.1 Group-Based/Team-Based Learning

Project-based learning usually emerged as group-based learning or team-based learning for peer learners. For example, Evans et al. (2018) examined on the design and implementation of a project-based learning where female faculty and students voluntarily collaborate on extracurricular mathematical research projects (p. 287). Leszczynski et al. (2017) explored that students were asked to create a free-standing movable structure as a means of testing and applying their understanding of the theoretical and conceptual elements of the course. The instructor guided the research of the groups while providing them with guidance on the basic concepts of physics principles (p. 27).

4.2 Interdisciplinary/Multidisciplinary

On the other hand, multidisciplinary was another crucial factor in the introduction of project-based learning. This has been applied across departments, across faculties, across institutions, or even through universities, locally and internationally. Students have also served together in the classroom or through disciplines. For example, Diamond et al. (2011) carried out a cross-faculty project in which UK higher education students worked as professional developers to create innovative educational games for academic clients from other subject areas. Brewer et al. (2015) announced that six faculties from the same university worked together to incorporate virtual teams into their classrooms (p. 208).

To sum up, project-based learning has been structured to include learners from various learning styles as in a small group or team-based collaboration; various competencies and technical preparation as in interdisciplinary collaboration; different cultures and ways of working/thinking as in collaboration across countries. This main function offered a learning opportunity for learners to work together to complement each other and to solve problems from different perspectives.

5 Community

5.1 Authentic Learning

In order to integrate real-life issues into project-based learning, students display greater motivation and commitment, as well as a deeper understanding of the

application of principles in real-life circumstances, as essential project results for students.

For example, in the first year of the Industrial Engineering and Management Program at the University of Minho, Portugal, Alves et al. (2016) implemented real-life PBL (p. 123). In the design of the curriculum, Svensson and Gunnarsson (2012) reported the success of the Design-Build-Test course in electronics based on professional and industry-like routines. Winther (2018) reported on a collaborative co-production film production project in which, through real-world learning processes, joyous, vulnerable, and subjectively experienced risk-filled circumstances became part of a shared creative educational journey (p. 1).

5.2 Development of Communities of Practice

PBL initiatives have fostered peer learners/professional communities of practice that have established a distinct way of learning centered on peers' similarly peripheral community involvement and have allowed students to support peers or professionals.

For example, Rand (2016) looked at a social science learning environment to create communities of practice that fostered learning experiences of students through anxiety, academic uncertainty, and emotional settlement during the learning process (p. 773). In addition, Fearon et al. (2012) have identified community practice approaches using group work emulating real-world practice to help develop transferable skills; building community membership through simulated teamwork roles encourages motivation; and group leadership helps to achieve a common goal (p. 114).

5.3 Work-Based Learning with Professionals and Field Practitioners

Work-based learning program designed to provide opportunities for effective applied learning experience where students have formed partnerships with community stakeholders, including academics, senior university managers, and employers' representatives (Smith et al., 2013).

For example, Dubus (2014) developed a project-based learning opportunity for successful applied learning experience for graduate social work students who formed a relationship with community members to support and address the social justice needs of the host community where each host community defined its own needs. In addition, Lockrey and Bissett Johnson (2013) reported on a connection between an industry partner and undergraduate students of Product Design Engineering for the Design for Environment course. Students have contributed to reducing the environmental crisis when they are based in industry, integrating credible technology options

with effective Design for the Environment methodology into the design process and outcomes (p. 70).

5.4 Work with the Local Community

The PBL involved collaboration with the local community, and the students benefited from the experience of enhancing the learning experience of students, engaging students in broader and deeper learning concepts.

For example, Ellis and Weekes (2008) reported on a local community project where a group of students working on their master's thesis were working together on sustainable regeneration issues in a small Irish market town (p. 482). In addition, Bobroff and Bouquet (2016) reported on an outreach project where students decided on their own theme and format and ended up in a public show. Student production also covered all fields of physics, and various formats were used, including experimental devices, animation or fiction films, games, live events, photography. Kim (2018) reported a project-based community participation course in which students choose research topics that are relevant to the local community. The projects have received favorable reviews from community stakeholders and professional geographers (p. 235). Sheffield et al. (2017) reported a study in which female tertiary students were trained to mentor small groups of primary school students to complete the STEM MakerSpace project in classrooms (p. 148).

In conclusion, PBL has been widely implemented with local community initiatives, professional community partners, and community of practice creation. This increases the motivation and dedication of students. It encourages students to apply learning to real-life problems in local communities and professional communities through community projects and service-learning projects.

6 Design

6.1 Research Projects as the Learning Tool

Many students experience difficulties in acquiring knowledge and skills in research methods and statistics, although basic competence in this field is central to many undergraduates. PBL has been widely used in the teaching of research methods. Students participate in research projects and learn better in a variety of ways, including a better understanding of the material, ability to write, experience in the development of experiments and/or research design, and better data evaluation.

For example, Kosinski-Collins and Gordon-Messer (2010) have implemented a project-based laboratory curriculum. Simple exercise has been found to improve students' comprehension of the content and their ability to write abstracts and solidify

the underlying relations between multi-week procedures (p. 578). Wyatt (2005) incorporated original research projects into the work of college courses. Students gain not only expertise in setting up an experiment, but also the ability to better determine experimental parameters and better interpret data in text, periodicals, and news stories (p. 83). Al-Maktoumi et al. (2016) reported on research-based arid zone hydrope-dology learning projects conducted by teams of undergraduate students. Results found a high level of student satisfaction and projects best suited to research-based learning (p. 321). Boyle et al. (2014) used a game-based approach to teaching research methods. By asking students to prepare a narrative review of games, animations, and simulations, students used their research skills to engage in the process and finally produced a synthesis of the relevant papers.

6.2 As an Alternative Assessment Approach

PBL has combined with other pedagogies to assess the competencies of students from different perspectives. Studies have also measured obstacles using PBL as a method of assessment. The evaluation is one of the main issues in the application of the PBL.

For example, Frank and Barzilai (2004) reported on the implementation of a PBL design for the appropriate research method course for pre-service teachers studying for a Bachelor of Science in science and technology education in parallel with the study of the Faculties of Science or Engineering. The final results of the project are group and individual written reports, a portfolio, a multimedia presentation, and a physical model. The study shows that PBL could be an alternative approach to assessment (p. 41). Menéndez-Varela and Gregori-Giralt (2016) looked at the validity of a rubric-based performance assessment. The achievement of the learning objectives and the proof of learning success have shown the validity of the inferences derived from the evaluation method, which should be regarded as a first-order teaching mechanism and not only a scoring tool (p. 228).

6.3 Learning Outcomes from PBL

In the design of the PBL, one of the key issues is to clearly define learning outcomes, while in the PBL process, students have a rich learning experience during the journey.

For example, Smith and Thondhlana (2015) investigated the demands of a first-year business case study group undergraduate project. The project document was found to be comprehensive and multifaceted, and the interconnected activities were highly collaborative and exceedingly complex in terms of cognitive and code difficulty and communicative stress (p. 14). Pomales-García and Barreto (2014) conducted a comparative study of student self-reflections on course projects in two engineering design courses for 161 undergraduate engineering students. Results

have shown that “application,” “true life,” “satisfaction,” and “communication” are common keywords shared in the reflection (p. 685).

6.4 As an Innovative Pedagogy

PBL has been considered as an innovative pedagogy in many empirical studies. PBL has been integrated into the curriculum as both a learning tool and an assessment tool.

For example, Kantola and Kettunen (2012) reported the design of a combined model using PBL teaching methods. The integrated model structure included approaches to innovation pedagogy, strategic higher education planning and research, growth and innovation (RDI) in order to promote the export of higher education. Findings have shown that drop-out rates have decreased; the duration of the study has decreased; knowledge transfer has increased; student supervision has increased; project students’ experience has increased employment opportunities and an integrated model of innovation pedagogy could be exported to other countries (p. 7). Altay (2014) has studied a human factors course that applies learner-centered methods to teacher-centered design. It was found that the tasks developed the knowledge, attitudes, and skills of students reflecting on themselves, their social and physical environment. Learner-centered training complements tutorial sessions and one-on-one to improve user-centered learning in various stages of cognitive and affective domains (p. 138).

In conclusion, project-based learning curricula design provides creative pedagogy rather than conventional classroom tests of predetermined responses with the only right solutions. Educators need to be more open to careful consideration in designing the learning environment so that students can achieve a rich learning experience in the learning process.

7 Technology

7.1 Technology-Enhanced Learning in General

Technology can enhance the learning process. It enhances communication, collaboration, and peer interaction through the use of information and communication technology. The online and virtual learning environment provides access to learning resources at anytime and anywhere. This facilitates cooperation across campus and across countries. It also facilitates more convenient communication between students, teachers, industry partners, and community stakeholders who do not need to meet at a physical location.

For example, Tesdell et al. (2005) reported on a technology-enhanced educational reform initiative at the University of Eastern China to better prepare English majors to use new technologies for international communication, collaboration, and research. Project-based teaching has been shown to enhance learning processes and outcomes by increasing authentic engagement, allowing greater flexibility to be learned, and delivering material that is more important to students' lives and careers (p. 104). Cutrim Schmid and Hegelheimer (2014) introduced a vocational development plan that included the creation of school-based research projects that student teachers needed to design, introduce and test technology-enhanced EFL lessons in partnership with in-service teachers. School-based experience has helped them to use technology in realistic language teaching scenarios and to assess the effect of technology on language teaching and learning (p. 315).

7.2 Collaborative Tool Enhancing Communication and Co-work

Collaborative tool promotes teamwork and collaboration within and between groups and teams. It promotes communication and interaction through collaborative technology. It improves the learning experience of the project process.

For example, Van Rooij (2009) explored the impact of project management tools on the PBL. Teams engaged with interconnected conversations during the lifecycle of the project. Results showed that the project established online project-based learning and encouraged intra-team contact and constructive collaboration actions (p. 210). Kim and Lim (2018) documented a collaborative design of the PBL in a real environment. Collaborative scripts used to help socially shared metacognitive control have been shown to have a positive effect on participants' experiences in team planning and information building (p. 194). Chen and Teng (2011) reported on computerized tool support for the design, management, and maintenance of the collaborative teamwork required for senior software engineering projects. The program was found to promote cooperation and ensure that collaborative efforts were maintained during the creation of the project (p. 802).

7.3 Specific Systems and Applications Enhancing Learning

Simulation, virtual reality, and e-portfolio are some of the examples that enhance learning. They provide a rich learning experience and engage students more in learning for deeper conceptual building.

For example, Plank et al. (2011) reported on an interdisciplinary collaboration using an agent-based simulation project where students learned about complex

systems and environmental issues, including climate change and watershed protection, through a simulation game (p. 35). Morales et al. (2013) focused on project-based learning in a virtual reality class. Students are expected to program an industrial Virtual Reality (VR) machine and at least one educational application of VR where students learn independently. Project-based learning can be found to be successful even with limited instructor guidance (p. 791).

7.4 Collaborative Writing Wiki

In addition to collaborative communication-promoting tools, in particular, there are collaborative writing tools that promote collaboration, for example, Wiki has been widely used to foster collaboration among learners. Collaborative writing platform wiki allows multi-users to co-edit and co-write at the same time that all updates are preserved in history.

For example, Roussinos and Jimoyiannis (2013) reported on a wiki project designed to promote collaborative writing and learning by university students. It helped understand the commitment of students, the contribution to content, the patterns of collaboration, and content co-creation followed during the timeline of the project. Stoddart et al. (2016) reviewed a variety of collaborative wiki-based writing projects. It was found that these writing assignments support the acquisition of second language (L2), peer-to-peer learning (P2P), communication and immersion in emerging technologies that educate students' social and professional lives. The climate encourages student happiness, motivation, and learning (p. 142). Page and Reynolds (2015) documented a case study in a collaborative writing project with and across wiki contexts. Studies have shown that participation in the project has had a positive relationship with student exam success and site familiarity (p. 988).

7.5 Web 2.0 Tool

Web 2.0 promotes self-publishing, social networking, multimedia, interaction, and community building. They have been integrated to enhance PBL learning.

For example, Huang et al. (2014) reported a study in the U.S. undergraduate education system reported their impressions through online surveys using Web 2.0 applications for a major course project. Web 2.0 applications have been found to be effective in helping to complete their projects by stimulating the attention of learners and promoting their trust during the learning process. The Motivational analysis of learners has influenced learning outcomes, which has led to increased use of Web 2.0 learning applications (p. 631). Knight (2016) reported on a joint project of two arts universities to create academic learning futures using collaborative writing of a fictional story/blog. Hung and Huang (2016) reported using blogs to upload audio entries as an English-speaking learning and assessment tool. It was found

that speaking blog scores were a significant predictor of student oral presentation performance; participants viewed their blogging experience as positive; the speech blog was a good tool to showcase their learning process and help them reflect on their learning progress in a blog-based environment.

To sum up, new technologies in recent years have provided means of linking students to the completion of project-based learning, connectivity, collaboration, community building. Technology enables the process of project-based learning. It also enables communication between students in geographically dispersed locations. Access to applications allows students to learn and participate in a more secure and productive manner.

8 Discussion

Four common themes emerged from project-based learning studies

This study reviewed 142 prior project-based learning studies between 2003 and 2019. Four common themes emerged, including *collaboration*, *community*, *design*, and *technology*.

8.1 Collaboration

Collaboration has emerged as a common theme in project-based learning studies. The collaboration as a theme is supported by various learning theories, such as the cooperative communication in the interactionist approach of Krashen's Input Hypothesis (1985); the role of social interaction in creating the environment of learning in the sociocultural perspective in part from the concepts of Vygotsky (1978), group awareness that reveals collaborative behavior of group members and regulates their participation (e.g., Lin, 2018). A recent review of deep learning studies identifies collaboration as effective learning (e.g., Ma, 2020).

Although project-based learning can be designed as an individual project and can be completed by one student, many of the previous studies are designed to be group work or team work. This composition of teamwork is not limited to a course or program, but also applied to interdisciplinary combinations across programs/departments/faculties, campuses, or even across countries. Most of the studies have been shown to have partnerships on a regional, multinational, and global scale. The learners have different educational histories. Learners come from different cultures and work together to find creative solutions to real-life problems.

The importance of working together is closely linked to the nature of the design of project-based learning. Students do things together, and work in various areas of knowledge.

Once it comes to various activities of project-based learning, such as a social problem, a business strategy, or a theoretical analysis, things get complicated. The same aspect can be interpreted differently by learners from different backgrounds. A design student may perceive the needs of a customer in a very different way from an engineering student when designing a new mobile phone or an information technology device. A student in northern Europe may find 10 degrees Celsius very warm, but it is very cool compared to a student in Southeast Asia. The argument from a learner's point of view may be contradictory to another learner. These may be perceived as biases between one student and another student. The discussion on open-mind and biases appeared in project-based collaboration work has been shared by scholars in international forum (TurkuAMK, 2020).

Learners are doing things together. When learners exchange information, they can work together to understand from each other's lens and to understand different backgrounds and cultures. The real essence of collaboration is the need to connect to turn certain differences into collaboration. The power to turn contradictory perceptions into collaboration enables learners to understand reality from a different angle. It helps learners to bring together the profound diversity of views to create something new that the learners have not yet known. This is done through negotiation and collaboration. It is about helping learners to become critical about the differences and helping them to generate ideas through critical thinking. Learners can bring about better change, better creativity, and better solutions as a result of real collaboration.

Open mind is the key to collaboration. Learners should concentrate on potential ideas rather than disagreements within the community. The members of the group have no prejudice of any kind to the ideas that are evolving or to the ideas that the member of the group says. It is important to allow for other voices. It is not supposed to not listen to voices that do not match with our own. It should not be empowered to exclude other roles. Collaboration, doing things together, means having different positions, exchanging, or sharing the power to have a voice and to be part of the decision-making process, to be motivated by the diversity that a community brings to the process. Collaboration community gives gratitude that produces ideas, and no one prevents the flow of ideas. A community or a team is working together to evaluate the resources. The group gives passion and emotions, including discomfort, fear, or optimism. All the roles must come together to create a synergy.

Similar minds are working together. However, if the learners are not of a similar mind, that is where the challenge lies, and that is where the members of the group should have an open mind to allow collaboration to take place. To be open-minded, to share understanding, to do things together, even though they are not the expected ones. That lies the most benefits from collaboration.

In the beginning of a new project, the educators may brief the participants on the aims and the goals for collaborative team work. The educators may explain the challenges during the collaborative process. The educators may outline the effective collaborative process to the students. Only then would participants benefit immensely from collaborating.

Project-based learning requires the interdisciplinary collaboration of students who benefit from a broader perspective in solving challenges and presenting innovative solutions in the learning process.

8.2 *Community*

Community has emerged as a project-based learning theme. It is supported by John Dewey's educational and social philosophy which provides the theory of community service learning, including learning from experience, reflective activity, citizenship, community, and democracy (e.g., Giles & Eyler, 1994).

When educators design project-based learning curricula, they leave the traditional classroom setting. They are going to the community and they are looking for real-life problems. Educators work with professional bodies and industrial partners. They will also work with other people, such as NGOs and organizations. We address the challenges of daily life, the technical skills needed, the expertise and experience gained in solving the problems, how theory can be applied to the workplace and how practice informs education. Educators then design their curriculum to include partnerships with different stakeholders to enable learners to address real-life, genuine community issues and learn through the completion of real-life projects. Learners research real-life problems and suggest solutions to them. As they know, they also contribute to the overall well-being of the community.

Education is a matter of learning by life experience. As broad as life-experiencing learners, learners would be able to face diverse tasks, learn the necessary professional skills and experience, and be better equipped to meet the challenges of completing their studies.

The role of educators in project-based learning design is critical in coordinating and receiving input. If project-based learning is planned in collaboration with professional bodies and industrial professionals, it is about various ways beyond the conventional classroom. It is going to be challenging for working life in the real world. Industrial professionals and practitioners are people who work with challenges on a daily basis. Teachers, as teachers or as facilitators of learning, need to ask them to provide very constructive and very specific feedback to the learners on how to deal with the challenges, how to tackle the problems, or how they see the resources to solve them. If the learners propose solutions, what is the value of the solution? What needs to be changed regarding their initial proposal? Students seek input from experts and practitioners who have rich life experiences and everyday challenges. It is not necessarily a matter of judgment, assessment, score, or ranking. Students are interested in very specific remarks about what is working and what is not working, what needs to be improved. This is the process of learning.

On the other hand, this is still a purposeful learning process. Since the project is developing and operating in collaboration with real-life problems, educators are designing the environment as a learning tool. Within such a learning environment, educators need to encourage the creation of new concepts and trials. Students would

be permitted to fail and should not be afraid to fail. Students learn different skills when they are going through a failure cycle. They also learn to stand up with discomfort. Educators and community members will be able to help the trials. Educators should make clear the understanding and expectations of both students and industrial partners. Industrial partners should not expect students to work like an employee or a consultant company. Students are not expected to come up with commercial and quality final products to replace current employees.

Project-based learning is designed to collaborate with industrial partners and professional organizations so that students can benefit from project completion as a learning process.

8.3 *Design*

This theme emerges as a collection of different enablers in project-based learning processes. Project-based learning pedagogy is structured to inspire students to learn. Students engage in group events and participate in the learning process. This self-motivation to learn comes from several causes. The project, for example, allows students to plan their work. This autonomy gives greater satisfaction to individual learning. In fact, the idea is often followed by performances. Students are happier to come up with something that they create or construct. On the other hand, the assessment of project-based learning will be distinct from conventional classroom tasks and assignments. There should be no standard answer. Failure in the project does not mean failure of the assessment. The goal and expected outcomes should be clearly defined so that students learn and benefit from even the failure process. All of these integrate students' motivational resources into the curriculum to a success in learning that is well supported by motivational theories (e.g., Schunk & Zimmerman, 2012) and the self-determination theory which provides the explanation why autonomously motivated students thrive and it explains why students benefit when teachers support their autonomy (e.g., Reeve, 2002).

Project-based learning requires aspirations and innovation to solve real-life authentic problems with the focus on the process itself. The process should be self-organized. Students should understand that this confusion of not being told what to do is part of the learning process. Educators may provide support but should not take away the opportunity of the students to self-organize throughout the process.

Project-based learning requires aspiration and innovation to solve real-life challenges with a focus on the process itself. The method should be self-organized. Students should understand that this uncertainty over not being told what to do is part of the learning process. Educators may provide encouragement but should not take the opportunity for students to organize themselves in the process.

Project-based learning is not to repeat a traditional classroom setting of structured program, systematic content, fixed learning material, and standard answers. On the contrary, project-based learning involves real-life authentic problem in society, a lot of stakeholders where the problem can create confusion to students and the problem

can be complex and complicated. The learning should be flexible instead of organized, structured, and fixed. Assessment should not be based solely on the educators with one standard answer. Learning is not necessary to be successful, failure is also a part of the learning process.

Educators should tolerate insecurity and uncertainty. Educators might not see the results as planned or not planned but still can see that there will be good results in one way or another. Learners may learn different things as what learners think they would learn. Educators do not have to plan everything very seriously and in detail. Still, learners learn a lot of things and gain competences that learners will be able to use in future working life when they graduate from the institute as a learner.

Educators should design the curriculum to provide support, with a community of learners and a community of learning. Learners are being able to trust that community and go through challenges. That does not mean to have one correct ready solution but the awareness of having to come out with the solution. It is about having community to do it with the learners of not being alone. It is about the connection, the support and the network of support, the tools the learners have, being supported and being prepared with tools, with resources, with having the views from the peer learners.

Project-based learning is designed to give students autonomy and motivate them to prepare, coordinate, carry out their work, and to enable students to develop and acquire skills in the process, irrespectable to the final success or failure of the project itself.

8.4 Technology

Technology emerges as one of the themes in project-based learning. Many project-based learning develops online and virtual learning environment that support interaction, communication, collaborative learning, and the sense of online learning community. This theme aligns with the arguments and evidence of prior studies on learning theories that the role of technology enhances learning (e.g., Gunawardena, 1995; Roberts, 2004; Warschauer, 1995).

Learners make use of the tools available to interact with other members. Learners join discussion forum to share learning experiences. It is because of the online learning environment, learners are able to communicate with other learners from other departments, other campuses, and even other countries. Online learning environment provides support for learners to communicate at any time and at any place. With the online learning environment, learning communities are formed. Members may come from different year of studies or different disciplines. Learners may support each other in various ways. There is also project-based learning designed to incorporate professional field practitioners. They act as mentors and provide practical feedbacks while projects are in process. There are also specific applications that facilitate communication and collaboration. For example, social media such as Facebook, Twitter, blogging are incorporated into the projects to enhance communication

among the learners; wikis are incorporated to enable collaborative writing for project work, self-reflection, and co-designed instructional guides.

It is because of emergent technology nowadays, in education, we have different platforms, different tools in ways to engage students. However, technology may also give fear that is not going to work. Learners in the group may feel lost. Learners should give very hard work putting people together to understand what is important. Therefore, it is important to understand why students do not use technologies offered to them; what kind of problems students meet in using the technologies; what support students expect to receive in order to fully utilize the technologies.

In the review of the project-based learning studies, many different types of technologies and applications were found to be developed and applied to facilitate students' learning and to engage students. For example, there are simulation applications to help students visualize the industrial environment they need while staying inside a traditional classroom. When students work on real-life projects, this helps a lot. Students do not need to go to the work sites every time. Students are able to understand the real-life problems and develop their prototypes during the process. They can then test their work at the very end of the process. Similarly, there are other studies adopted virtual reality/augmented reality applications that provides similar effect to help students understand the real-world context. Students can practice as many times as possible until they are familiar with the situation, before they really need to go to the work sites at a later stage.

Wiki has been suggested in a few project-based learning studies. Wiki is a collaborative writing platform. Students can create pages, edit content, at any time and at any place. It supports co-editing simultaneously. In many of the collaborative writing tasks, wiki provides a perfect platform for students to work together. There are several studies involved students from different places or countries. Wiki allows them to write at different time zone that the writing always grows: while one sleeps, another student is working alternatively.

In recent years, the mobile phones become the most convenient tool to access these applications and platforms at any time and at any place. A mobile phone functions the same, or even better at times, than a desktop computer. It facilitates communication, collaboration, and support always. Its ability to search for information around the globe enhances knowledge sharing and transfer throughout the project process.

Technology facilitates social contact, interacts, and offers encouragement to a group of learners. This is an important enabler in the design of project-based learning and in the learning process.

8.5 Limitations and Further Studies

This study reviewed project-based learning studies published in the past twenty years and included in a single multidisciplinary database. The review is not exhaustive. Further studies could conduct similar reviews using other databases to examine whether the same conclusions could be found in order to expand the applicability

and the generalizability of the results of this study. An additional limitation, as in other qualitative studies, is that the instrument developed for analysis might have involved the subjective judgment of the researcher, leading to validity issues in the different parts of the analysis process: the generation of keywords, the grouping into categories, and the extraction of the main themes. Further studies in the area could increase the generalizability of the results. This highlights the importance of evaluating the logic and reasons used to explain the relationship between the keywords and project-based learning. This study has attempted to cite the findings and arguments from selected references to provide the rationale behind the analysis. Therefore, the various learning theories have been cited to support the findings in this study in spite of the limitations in the research process.

9 Conclusion

This study sampled project-based learning studies in the last twenty years and came up with four themes identified in these studies, namely, collaboration, community, design, and technology. The studies reviewed demonstrated empirical evidence that shows the enablers and project-based learning. This study contributes to a better understanding of project-based learning: it defines the design strategies that are useful for achieving the ultimate goals of project-based learning, identifies the factors that explain project-based learning, and summarizes the effects of project-based learning.

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The Role of Online Course Design in Associating Second Language Learners' Motivation and Self-regulated Learning Strategies in Non-formal Online Learning Contexts



Shuqin Zhai and Min Lan

Abstract This study aimed to investigate how the online course design features influence the relationship between learners' language learning motivations and self-regulated learning strategies (SRL) in non-formal online learning contexts. Using an in-depth interview method, eleven Chinese university students were recruited for one-on-one synchronous meetings. Thematic analysis with constant comparison was conducted to generate themes and associations. One key result showed that eight online course design features—Multimodal and authentic interactive forms, Instructor traits/approachability, Financial stimulation, Task relevance and difficulty level relating to learning outcomes, individualized video length, Tools to promote effective time management (i.e., Da Ka—daily check in), Tools to prompt co-regulatory contribution from a study partner, and Tools for controlling the learning pace—were identified having stimulated L2 learners' motivation and facilitate their task strategies. The implications for theory and practice were discussed.

Keywords Online course design · L2 motivation · Self-regulated learning strategies · Non-formal online learning contexts

1 Introduction

Concomitant with the rapid growth of technology and internet, language teaching and learning have no longer been confined to offline classrooms but have partly switched to online contexts with the scaffold of technologies. As a result, a growing number of learners is participating in non-formal language courses online such as Language MOOCs (LMOOCs) and Language Learning Social Networking Sites (LLSNS) (Godwin-Jones, 2019). Meanwhile, learners' success in online second

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language learning (L2) is highly driven by their self-initiated motivations (Wang & Zhan, 2020; Zheng et al., 2018). Also, in the online learning environments, learners have to rely on themselves to self-regulate their learning to decide when, how, and what to learn (Milligan & Littlejohn, 2014). Whereas most of the previous research on the relationship between students' motivations and self-regulated learning (SRL) strategies has focused on either general online learning (i.e., Littlejohn et al., 2016; Swafford, 2018) or offline classroom language learning (i.e., Kavani & Amjadiparvar, 2018; Mahmoodi et al., 2014), the relationship between learners' second language motivation (L2 motivation) and SRL strategies in online learning environments has been insufficiently investigated (Zheng et al., 2018).

Additionally, despite learners' extensive interactions being regarded as a significant factor influencing learners' success in online L2 learning (Bárcena et al., 2014; Beaven et al., 2014; Martín-Monje et al., 2017; Uchidiuno et al., 2018), the actual interaction participation has been rather low due to various reasons, i.e., unresponsive platform designs (Uchidiuno et al., 2018) and extra time and efforts required (Beaven et al., 2014). This phenomenon happened under the condition that learners owned high intrinsic motivation (Uchidiuno et al., 2018) and being fully self-aware of the importance of peer interactions for L2 learning (Beaven et al., 2014). It hence merits further research on excavating deeper understandings on the associations among the affordances of online language courses per se, learners' language learning motivation, and social aspect of learners' self-regulation.

Thus, we conclude the gap for the current research—there is a shortage of investigations on how the online course design components influence the relationship between learners' L2 motivations and SRL strategies in online contexts. We specifically set our research in online non-formal language learning settings. As there are many contested definitions of non-formal learning, we follow Eshach (2007) that non-formal learning takes place outside school education without usual support. The learning is often prearranged and structured, usually out of voluntary learning, not sequential, and not assessed (Eshach, 2007). Additionally, previous research (Lai, 2013) held that it is essential to maximize the benefits of technology use for language learning through scaffolding learners' self-directedness in using technology in out-of-classroom language learning contexts. Therefore, it is needed to study language learners' self-regulated learning in out-of-class language learning contexts.

Two objectives are included in the present study. First, we explore how L2 motivation and SRL strategies influence learners' L2 learning in online contexts. Second, we pay attention to how online course design components respectively exert influences on L2 motivations and SRL strategies in online language learning environments. The current study provides a new contribution by situating self-regulated learning in online second language acquisition/learning field and proposed the SRL and L2 motivation model which is expected to inform intervention supported by online course design in learners' future online self-regulated language learning.

The rest of this paper is organized as follows. First, it includes a literature review of synthesizing previous research on L2 motivation and SRL strategies in online learning contexts. This is followed by a description of the pre-defined theoretical framework grounded in the research. Third, we introduce the methodology of this

paper including participants, data collection, and data analysis. Subsequently, we display the results emerged from the data and discuss the results by connecting to previous literature. We then summarize the implications for theory and practice. Finally, we conclude by stating the limitations of the current research as well as highlighting several directions for future work.

2 Literature Review

2.1 L2 Motivation and Online Self-Regulation

L2 motivation was found having significant predictive power of learners' online self-regulation in online L2 learning environments, though this was not consistent across the extant research. For instance, learners' cultural interest in the Ideal L2 self significantly and positively predicated the goal setting, time management, and self-evaluation of SRL while learners' L2 learning experience showed a significantly negative relationship with learners' task strategy use (Zheng et al., 2018). Also, the research revealed that learners with positive perceptions on previous online language learning experience contributed less efforts to online language learning, despite the fact that it contradicted with Wang and Zhan (2020) in which positive influence was exerted by learners' prior online language learning experience on learners' online English learning. In spite of this, the two research shared the finding that an intrinsic interest in the English culture was able to sustain learners' learning efforts (Wang & Zhan, 2020; Zheng et al., 2018). Moreover, Zheng et al. (2018) indicated that learners' Ought-to L2 self such as avoiding negative academic performance which generated negative prediction on their online self-regulated language learning. It was echoed by Zheng et al. (2016) in which the finding suggested that learners' emphasis on exam success would direct them to rather superficial language learning, which negatively relates with their online self-regulated language learning with regard to goal setting, time management, or task strategies.

However, based on the Self-Determination Theory (SDT) (Deci & Ryan, 1985), Lin et al. (2017) indicated that either learners' intrinsic or extrinsic motivation showed no significant predictive relationship with learners' self-regulated language learning in online learning settings. The reasons behind this were attributed to that motivational mechanisms may function differently in online environments and low learner motivation level in participating in online language learning also mattered (Lin et al., 2017). Therefore, on the basis of the extant research focusing on the relationship between L2 motivation and learners' self-regulated language learning online, we could conclude that although research (Wang & Zhan, 2020; Zheng et al., 2016, 2018) was all set in Chinese contexts, there were disputed findings among them, particularly on how previous online L2 learning experience and learners' examination concerns in L2 motivation relate to their online self-regulated learning strategies

use, which hence needs to be further investigated. Other than that, the reviewed literature relied on quantitative statistics from surveys, which should have been more convincing if having been complemented by more in-depth qualitative data with respect to interpreting the role of L2 motivation in learners' self-regulated online language learning. Particularly, more research is expected to carry out from the SDT perspective in order to further explore on the topic concerning the inconsistent results reported in Lin et al. (2017).

2.2 L2 Motivation, SRL Strategies, and Online Course Design

Learners' L2 motivation and SRL strategies also connected with the online language course design. For instance, Chik (2019) found that the integration of a user-generated and teaching community has motivated Duolingo (an LLSNS) users to raise questions and give instructions, which in turn contributes to more authentic language learning opportunities for learners. The task design of completing a language skill tree also brings learners to gamified learning mode which hence maintains learners' interest in formal language learning settings (Shapiro, 2015). Besides, the design of a following reverse tree endows learners the opportunity to go beyond merely imagining their ideal L2 self but practicing their ideal L2 self through translating the target language into their mother tongue (Chik, 2019). Although this research proposed how other-motivation in the social network community contributed to learners' L2 development, the generation of such opportunities for other-motivation depends on learners' own attention in the community (Chik, 2019). In other words, learners would still highly rely on their self-regulation to participate in such peer interactions. However, this research has not gone further in this regard. Moreover, Lai (2013) confirmed that learners' L2 motivation reflected as interest and task value beliefs exerted direct effects on learners' self-initiated technology use and indirectly influenced learners' self-regulation in L2 learning with technology. Learners' L2 motivation together with facilitations from instructors and peers influenced learners' interactive relationship with technology use in language learning. Thus, according to Chik (2019) and Lai (2013), we could conclude that learners' L2 motivation could support their self-regulated technology use in L2 learning and meanwhile the technology affordances such as social network community would in turn generate other-motivations for learners' self-creation of authentic learning environment.

Nonetheless, technology affordances supported by the online language course design are not equivalent to learners' technology use in learning an L2. Gilliland et al. (2018) suggested that in addition to linguistic input and prompted interactions, LMOOCs should integrate multimodal affordances (social networks) to enhance peer feedback and interactions. Martín-Monje et al. (2017) revealed that learners preferred interacting with peers on social purpose rather than discussing course content. However, Chik (2019) indicated that learners have to self-regulate their

attention to the social media activities afforded by the online course design as not all learners would go beyond the basic learning contents and contribute to the peer interactions in the community. Beaven et al. (2018) involved social media activities on Facebook and Twitter in the LMOOCs in order to engage learners in social learning and improve interactions among learners. It collected learners' intrinsic motivation data and found that learners' expectation on relatedness was moderately high while this has not been met for learners' learning on the LMOOC platform. It hence argued that the discussion forums should be well integrated and seamlessly built into the task activities in order to support learners' need of relatedness for social learning. This corroborated the Basic Psychologic Needs of Deci and Ryan (1985) which declared that human-beings have to be satisfied with needs for autonomy, competence, and relatedness before taking actions. Therefore, we could infer from the extant literature that whether technology affordances would be utilized by learners highly depends on whether the design satisfies learners' basic psychologic needs (Deci & Ryan, 1985).

2.3 Online Course Design Features and SRL

It hence further raises a question over what kind of online course design features would be able to facilitate learners' basic psychologic needs for self-regulated social learning and peer interactions. From the perspective of SDT theory (Deci & Ryan, 1985), Lan and Hew (2020) proposed the course design features which are to enhance learning engagement in MOOCs by satisfying learners' basic psychologic needs. First, learners' active learning should be guaranteed by connecting the course to real-world issues and providing adequate interactive opportunities for learners. Second, the course contents should be concise, flexible, and visualized. Third, the instructors should be professional, of good personality, owning clear teaching style, and be willing to conduct productive communications with students through different approaches (i.e., forum, social media). Mikum et al. (2018) found that students' participation in peer interactions on social media was motivated by instructors' presence and the largest group size brought the highest participation rate in peer interactions on social media. This was in that more audiences in the group encouraged the superusers to post more information. On the contrary, Kim (2013) indicated that a larger group size negatively influenced learners' interactivity and hence it suggested a sub-grouping method to improve the quality of participation in online discussion forums. Albeit different research contexts, the different findings on how group size influenced learners' participation in interaction would deserve more studies exploring on the topic. Nevertheless, it is still unknown whether these identified course design features from rather general online learning contexts would also be applicable to online language learning settings. Hence there is a need to further research the key factors influencing learners' interaction participation in online language learning contexts as compared with the features mentioned in the reviewed literature above.

Based on the reviews, we found that there were still disputes among research on the relationship between L2 motivation and online self-regulated learning and the

corresponding online L2 learning outcomes since studies of online self-regulation and L2 motivation in online language learning contexts were still limited (Zheng et al., 2018). A paucity of studies has paid attention to how the online course design components influence learners' L2 motivation and SRL strategies use. Therefore, responding to the call for qualitative research to explore details of individual learners' L2 learning (Rose et al., 2018; Wang & Zhan, 2020; Zheng et al., 2018), the current study took an in-depth interview method and analyzed learners' own voices of their learning from a bottom-up manner. The research questions to be solved in this study are as follows:

- (1) How does learners' language learning motivation influence learners' online language learning?
- (2) How does learners' SRL strategies influence learners' online language learning?
- (3) How do online course design components influence learners' SRL in online language learning contexts?

3 Theoretical Framework

3.1 Self-Determination Theory (SDT)

Based on Self-Determination Theory (Deci & Ryan, 1985, 2000), L2 motivation consists of two major parts: intrinsic motivation (IM, out of the internal desire for personal pleasure), extrinsic motivation (EM, out of the desire for external rewards). Meanwhile, IM is further divided into three categories: IM-knowledge referring to the pleasurable feeling when developing new knowledge and ideas, IM-accomplishments referring to the feeling related with achieving a goal, and IM-stimulation referring to the sensations aroused by doing a task (Deci & Ryan, 1985, 2000). Likewise, EM is categorized as integrated, identified, introjected, and external regulation with a decreasing autonomy from high to low (Deci & Ryan, 1985, 2000; Lin et al., 2017). According to Lin et al. (2017), identified regulation means that one learns an L2 because of the benefits behind this behavior; introjected regulation means that one learns an L2 in order to avoid feeling guilty or keep self-esteem; and external regulation means that one learns an L2 because of external elements such as pressures, expectations, or rewards. Integrated regulation refers to how one's L2 learning behavior is integrated within personal values and beliefs (Deci & Ryan, 2000). The elements involved in SDT theory would be considered to conceptualize learners' diverse L2 motivation patterns in online learning environments.

3.2 Six-Dimensions of Self-regulated Learning (SRL)

Self-regulated learning refers to the extent to which learners take their cognitions, motivations, behaviors, and affects in a systematic manner to attain their learning goals (Schunk & Greene, 2018). Zimmerman (2000) proposed six dimensions of SRL within a cyclic three-phases process, namely the Forethought stage (i.e., planning, goal setting, etc.), Performance stage (i.e., monitoring of efforts, cognition, emotion, note taking, help-seeking, help-seeking, etc.), and the Reflection stage (i.e., rewards, revising goals, etc.). Dembo and Seli's version of six dimensions of SRL (2008), an adapted version of six dimensions of SRL which was originally from Zimmerman (2000) includes: (1) Motivation (Why) refers to that learners owning high self-motivation would set goals for learning and also possess high self-efficacy. (2) Methods of learning (How) refers to that learners with high self-regulation tend to intentionally opt for their learning strategies that would generate increased learning outcomes. (3) Use of time (When) refers to that learners would decide to spend how much time on tasks by accordingly determining the importance of tasks. (4) Physical environment (Where) refers to that self-regulated learners purposefully prevent distractions in learning and are self-aware of supportive resources for learning. (5) Social environment (With Whom) refers to that learners would make their own decisions of studying with whom and seeking help when necessary. (6) Monitoring performance (What) refers to that learners would determine whether they need to make adjustments to their learning methods in accordance with the discrepancy between their actual academic performance and the performance needed to attain a goal. Hence this research will conceptualize learners' SRL by grounding on Dembo and Seli's adapted six dimensions of SRL (2008).

3.3 Instructional Design Principles

Lan and Hew (2020) proposed the course design features MOOCs should be equipped with in order to satisfy learners' three basic psychologic needs on MOOC learning from the SDT perspective. First, in terms of active learning, connectivity and interactivity of the courses should be taken into consideration by respectively involving in real world examples and interactive platforms (i.e., social media) or content (i.e., video lectures). Learners hence should be provided with adequate opportunities to interact with tutors, other learners, and course materials. Second, regarding course resources, the contents should be concise and well explained on the platform. Learners should be flexible to access the learning materials regardless of the time and space. The course should be well visualized by integrating videos and graphs into illustrating relevant contents. Third, with respect to the instructors, they should be professional to demonstrate the depth of specialized knowledge through instructions or interactions on the platform. Instructors are also needed to be necessarily humorous and supportive. The instruction should be performed by connecting to clear

Table 1 Pre-defined theoretical framework for coding

L2 motivation from SDT perspective (Deci & Ryan, 1985)		Six dimensions of SRL (Dembo & Seli, 2008)	Instructional design principles (Lan & Hew, 2020)	
Intrinsic motivation	IM-knowledge IM-accomplishments IM-stimulation	Motivation (Why) Methods of learning (How) Use of time (When) Physical environment (Where) Social environment (With Whom) Monitoring performance (What)	Active learning	Connectivity Interactivity
			Course sources	Conciseness Flexibility Visualization
Extrinsic motivation	EM-integrated regulation EM-identified regulation EM-introjected regulation EM-external regulation		Instructor attributes	Professionalism Personality Teaching style
			Instructor availability	Willingness to communication Behavior

examples for learners’ comprehension. Instructors should also be willing to carry out regular teacher–student interactions. They are also expected to actually respond to learners’ common issues. And finally, instructors should resort to multiple channels (i.e., forum, social media) to communicate with learners. Thus, this research will adopt the outlined course design characteristics as pre-defined principles to code the features of involved online language courses (Table 1).

4 Methodology

4.1 Participants and Data Collection

This study used an in-depth interview design to answer the three research questions. Based on convenience and snowball sampling, twelve Chinese university students who owned the experience of learning a target language other than their mother tongue were involved in. One participant was excluded because of unmatched learning context with our research needs. The included participants were aged from 20 to 26 years old. Seven of them were in English-related majors (i.e., English, English Teaching, TESOL, Translation, and Interpreting) and others studied in non-English-related subjects (i.e., Social Work, Electronic Computer Engineering, Finance, and Philosophy). The interview guideline was adapted from Littlejohn et al. (2016), which was grounded on Zimmerman’s SRL model (2000). It roughly contained thirty-seven items including general questions and those key questions

Table 2 Profile of participants

Participant	Gender	Education level	Major	Learning platform
Cathy	F	Master	Social Work	You Ling You Ke (paid in advance)
Chen	M	Undergraduate	English (Teaching)	CNMOOC
Wang	F	Master	English (Teaching)	CNMOOC; Bilibili
Christine	F	Undergraduate	Finance	Bilibili
Tang	F	Undergraduate	Philosophy	Recorded Hu Jiang video lectures; Duolingo; Gu Yue website
Alex	M	Ph.D. student	TESOL	CNMOOCs; Wangyi Open Course
Annie	F	Ph.D. candidate	Electronic Computer Engineering	Bilibili
Bu	F	Undergraduate	English	Bilibili
Haiyan	F	Undergraduate	English	Bilibili
Wu	F	Undergraduate	English (Teaching)	Haodaxue Zai Xian
Ivy	F	Master	Translation and Interpreting	You Ling You Ke (paid)

surrounding strategic planning, goal setting, self-efficacy, task interest/value, help-seeking, strategies, time management, self-evaluation, and self-satisfaction. Additional questions were also involved in interviews, depending on how interviewees replied to the questions from the guideline. Sample questions in the guideline are here: 1. How did you manage your time on this course? 2. Is the course meeting your expectations?

Besides, the first author translated the interview guideline which was originally in English into Mandarin Chinese before carrying out interviews. The one-on-one in-depth interviews were conducted through online synchronous meeting. The interview was planned to last around 60–80 min while the actual interview time varied depending on the situations of different interviewees. All interviews were done via either WeChat video or audio calls. Participants were all inquired for consent that the interviews would be recorded for further research purpose of the current study (Table 2).

4.2 Data Analysis

The recorded interviews were then transcribed into texts via an online transcribing website. Inaccuracies and typos were carefully checked before further analyses. Based on the interviews, thematic analysis with constant comparison was conducted

to generate themes and sub-themes, which meanwhile was combined with a “Framework” in the qualitative data analysis in order to detect the underlying associations among different themes and finally develop a new theory (Ritchie & Spencer, 2002). In the current study, the framework initially constituted the components from SDT theory (Deci & Ryan, 1985), the six dimensions of SRL (Dembo & Seli, 2008), and the adopted instructional design principles (Lan & Hew, 2020). While along the coding process, emergent themes and conceptualized themes from analytic data patterns are also involved in developing the new framework (see Fig. 1).

The data analysis is as follows: First, the transcripts were carefully read and reread to gain a full impression on the interview contents. During this process, the analyst also started the process of abstraction and conceptualization by making notes, writing down the recurrent themes and issues which were reported being important to respondents themselves. Following was to label the texts by sentence. One sentence could be repeatedly coded from different angles. Third, all codes were vetted and only the most relevant ones were then categorized. Fourth, to figure out the relationship among different categories, the labels and the coded information were iteratively compared. Fifth, to further identify the class relations behind the categories, a preliminary structure was drafted. For specific responses on each theme, narrative analysis was employed. All the coding process was done in MAXQDA 2020. To ensure the reliability of the coding process, any discrepancy or uncertain code would

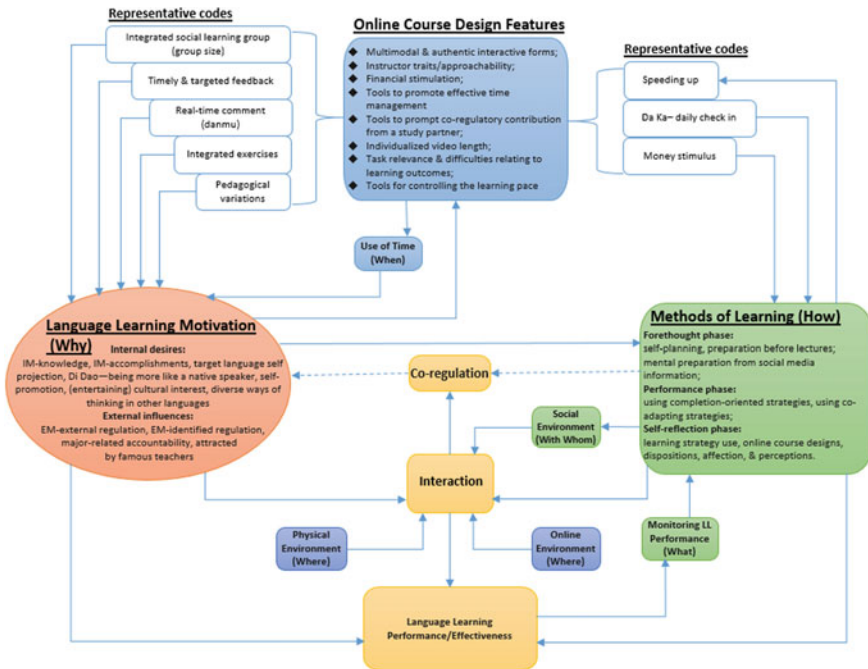


Fig. 1 Online self-regulated learning framework for second language

be discussed between the first author and the second author until reaching a final consensus.

5 Results and Discussions

Key points of the results

- (1) Learners' L2 motivation in the online context manifested their SRL, social interactions, and online learning performance. In reverse, the effectiveness of their SRL strategies and the learner's evaluation on their learning outcomes could fluctuate their L2 motivation.
- (2) Higher self-regulatory learners demonstrated a set of strategies during the performance phase in the online learning. However, social needs for promoting effective language learning in the online contexts were not met based on the courses taken by our interviewees.
- (3) Eight online course design features—Multimodal and authentic interactive forms, Instructor traits/approachability, Financial stimulation, Task relevance and difficulty level relating to learning outcomes, individualized video length, Tools to promote effective time management (i.e., Da Ka—daily check in), Tools to prompt co-regulatory contribution from a study partner, and Tools for controlling the learning pace—were found having been able to stimulate L2 learners' motivation and facilitate their task strategies.

In the following sections, the details of results and corresponding discussions among the six dimensions of SRL (Dembo & Seli, 2008) will be demonstrated. They are respectively the Physical Environment (Where), Social Environment (With Whom), Methods of Learning (How), Use of Time (When), Monitoring Performance (What), and Motivation (Why). A framework was derived for explaining online self-regulated second language learning (see Fig. 1).

5.1 *Physical Environment*

Hromalik and Koszalka (2018) found a rather weak association between learners' preparation of their work environment and their final success in learning since all participants were aware of doing the preparation work. A bit diverged from that, in this study, we found that whether learners were studying alone or studying in a group (i.e., in the library) could to some extent relate to their L2 learning performances regardless of their formal manners in both physical settings.

Self-regulated learners were able to prevent distractions during their learning and were able to realize the resources that could provide support (Dembo & Seli, 2008). Learners who studied at home, tended to organize a fixed block of time to study their online L2 courses in a formal manner in order to avoid distractions. However,

with no peer learners, these learners realized their own lack of self-discipline. The one who studied in the dormitory was able to focus on her learning while another reported being interrupted by roommates was also a problem. In libraries, learners perceived that they were able to center on their learning the most.

Other than preventing distractions from the physical environment, participants reported distractions from some digital activities, such as entertaining videos or irrelevant information in the social media. A participant indicated that using the smartphone's built-in control system could avoid such distractions to some extent.

5.2 *Social Environment*

According to Andrade and Bunker (2009), the transactional distance was the main cause of impeding learners' distance language learning and a high structured course would provide learners with abundant interactive opportunities with tutors, peers, and learning materials. Although learners demonstrated varying degree of help-seeking in this study, Kizilcec et al. (2017) found that help-seeking was not effective for learners to accomplish their learning goals in MOOCs. Even so, Gilliland et al. (2018) suggested that the integration of multimodalities (social network) may improve peer feedback in online L2 writing course.

Self-regulated learners indicated that with and from whom to study and ask for help would influence their online L2 learning (Dembo & Seli, 2008). However, consistent with Hromalik and Koszalka (2018), in this study, only few participants would intend to seek help via contacting the course instructors or peer learners in the online course community for clarifying issues they met, even though one learner indicated that a study partner would espouse their learning persistence. Learners owning a fixed connection with a study partner indeed reported peer support and monitor from which the co-regulation generated could in turn motivate participants to persist on learning. Besides, all participants reported that they prefer to use social media platforms (i.e., WeChat subscriptions, Weibo, Zhihu) to search information (i.e., strategy recommendations) and resources for solving confusions they encountered. Participants also utilized social media platforms to deal with task-related issues such as seeking a study partner to do oral practices. Some participants were inclined to seek exposure to public monitor via Da Ka on social media platform.

Many online language courses did not promote peer tutoring. Some LMOOCs may require learners to do peer commenting activities in discussion forums as a compulsory prerequisite for earning certificate, while participants did not reckon such interactions as authentic communications but rather mechanical. However, the learner felt a kind of interaction with the instructor for an online language course integrating gap-filling exercises from which the learner could pull back her attention to doing the exercises and check the answers with the instructors in the subsequent lecture time, though the video lectures were asynchronous in nature.

5.3 *Methods of Learning*

Chik (2019) found that for learners' L2 development in social community integrated in Duolingo, learners needed to rely on their own attention to direct them to those learning opportunities and resources afforded by such design. Echoed with this, in the present study, instead of merely relying on the online language course per se, higher self-regulated participants adopted more online resources in the larger online community. According to Zimmerman (2000), a highly self-regulated learner is prone to use diverse learning strategies to espouse their learning in different situations. This was also attested in the present study based on participants' self-reports.

Forethought Phase Different learners would resort to varying strategic planning and task strategies while learning. Learners with high self-regulation tended to make their own learning plans and made preparations before watching relevant video lectures. For some participants, they also searched social media platforms (i.e., Zhihu) for advice or plans for learning the target language before actually embarking on learning the courses. One interviewee reported that she was looking for the advice and experience posts on Zhihu in order to reduce her sense of fear or unknown. Either for specific learning resources or mental needs, learners' extensive use of social media at the initial stage of their learning was apparently discerned.

Performance Phase Speeding up video lectures were reflected as completion-oriented action, which these learners commonly did in order to quickly complete the lecture. Nevertheless, some learners used it because the pace of "PPT Reading" style instruction was too slow. According to one interviewee, the learner's goal of "being more like a native speaker (in Chinese 'Di Dao (地道)')" regarding the English grammar use and writing performance was unsatisfactorily fulfilled because the learner's reliance on speeding up the lectures gave rise to her slack in learning the online L2 course. In addition, another participant indicated that some important information having been leaked by speeding up lectures which drove her to return to the previous lectures to check. That frustrated the learner because she could not self-control the learning pace and that discouraged the learner from continuous learning.

Co-adapting using an additional resource was detected to satisfy learners' different learning needs (Godwin-Jones, 2018). Participants reported that they used different mobile applications to satisfy their various needs for language skills enhancement beside the online language courses per se. When the online courses did not satisfy participants' expectations, some stopped learning and sought other accessible resources to meet learning needs.

Self-reflection Phase Participants tended to reflect a series of details on their learning strategy use, online course design features, dispositions, affection, and even perceptions that were closely associated with learners' learning on the course. First, for a participant learning an English listening course online particularly for the listening skills, the learner reported that he had not actually done enough listening practices by utilizing those learned listening techniques. And that could help explain why his listening proficiency was not improved much. Second, the large group size of

a social learning group made participants feel sense of distance which also rendered the learners' refusal to participate in social interactions in the group. This contradicted with Mikum et al. (2018) which found that the largest group size contributed to the highest peer interaction participation rate on social media. Third, for a learner who reflected herself as an interest-oriented person, the participant preferred to study in a non-formal manner which however partially gave rise to her failure in learning. Fourth, for learners reported having been frustrated by or distasted on the courses, they tended to adopt a completion-oriented learning strategy (i.e., speeding up lectures). Finally, for those holding a view "learning was boring", they either did not successfully maintain learning behaviors throughout the course or reported apparent L2 learning effectiveness.

5.4 Use of Time

In the online learning environments, learners have to depend on themselves to decide when to conduct the online learning (Milligan & Littlejohn, 2014). In this study, learners' stress on examination seemed having a positive influence on learners' time planning and time use in the online L2 learning, though the task strategy of using speed button may conversely lead to a superficial learning. This contradicted with the findings in the previous research (Zheng et al., 2016, 2018) in which learners' emphasis on examination negatively predicted their self-regulation of time management.

Self-regulated learners make their own decisions of which tasks are of importance, how much time they would spend on each task, and how to perform the task in a more efficient and effective manner (Dembo & Seli, 2008). Learners' time management skill was influenced by their L2 motivation and the relevance and difficulty of the topic and task activities. For instance, a learner—with strong extrinsic motives such as improving L2 writing skill for the coming TEM 8 test and postgraduate entrance exam—only targeted on watching videos, would reckon that there was no necessity of doing the task activities. However, to shorten the time spent in watching the video lectures, the participant tended to be more task-driven in which the learner jumped part of the video lectures and directly did the tasks in a quick manner. Moreover, as the learner did not regard the online L2 learning as "a high priority", the plan organized for learning after dinner every day was easily intervened by other plans such as hanging out with friends.

Additionally, for a self-regulated learner who was motivated by the strong need of complementing the unsatisfactory school education and preparing all kinds of language exams, a more structured learning routine was strictly planned and executed by setting a fixed time to study the video lectures. The learner placed more value on the online language courses than on the school education under which condition he even spared the time which should have been put into preparing the school classes to study the online L2 courses. However, the mistaken SRL led to the learner's anxiety in offline school classrooms for the insufficient preparation for the classes.

5.5 *Monitoring L2 Performance*

According to Weiner (1992), some learners are able to make adjustments to learning methods in accordance with their feedback in that they attribute their progress to the adoption of strategies while other learners refrain from adapting because they tend to attribute their progress to external factors out of their own control. Rutherford (2017) proposed that high performers demonstrate better metacognitive monitoring which is usually operationalized as the accuracy of calibration. However, poor performers tend to perform poorly as well as are ignorant of their poor performance which would impossibly direct them to conduct self-corrective actions (Rutherford, 2017).

Self-regulated learners would decide whether they must modify their learning methods based on the disparity between one's actual performance and the expected performance (Dembo & Seli, 2008). The self-monitor process is expected to provide learners with self-feedback to guide them to revise their learning goals. For instance, one participant reflected that the discovery of speed button drove her to adopt a “*Tou Ji Qu Qiao* (in Chinese ‘投机取巧’)” learning manner. The learner believed that the course could have facilitated her to form a learning habit and correspondingly effectively enhanced her L2 as long as it had not been equipped with the speed button design.

According to the interviewees, the online L2 course without effective targeted feedback may prevent them from better academic performance. It was in that such design violated her perception on the crucial role of instructors' targeted feedback in helping students enhance their L2. Apart from that, as a learner found out the instructors' “PPT reading” teaching style on the LMOOC, she calibrated her initial high expectation on the course to finish all lectures. Correspondingly, the learner managed to maintain her learning behavior driven by her strong extrinsic motivation-external regulation (i.e., exam preparation). For some higher self-regulators, they would stop learning and regulate their future learning by resorting to other learning resources and methods when the course cannot meet their needs. However, for a participant who did not set proximal goals and seldom reflected his L2 learning progress, he was prone to neglect the fact of the ineffectiveness of the L2 course but chose to stick to his own learning plans with a conviction of “learning progress happens slowly”.

5.6 *Motivation*

Language-learning motivation differentiates itself from the general motivations for it involves both learners' personal attitude on the target language community and reflects a way of obtaining social and cultural resources from that community as well as may relate with how learners perceive the status and power of a specific language (i.e., learning English because of the global power of U.S.) (Dörnyei, 1996; Lin et al., 2017). From a more general perspective, learners owning high self-initiated

motivations would set goals for their learning, possess high self-efficacy, and believe they could attain academic success through putting adequate efforts (Dembo & Seli, 2008). In this study, eleven motivation types were identified and separated into two major types—the internal desires and the external influences. Learners' intrinsic L2 motivation did not remain throughout the course but the calibration of learners' motivation and the initial expectation of deriving high L2 improvement were detected based on learners' descriptions of their interactions with the online course design components. The instructor traits (i.e., instruction style), the group size of the social media feedback group or of the discussion forums, and the financial incentive were reported to have reduced learners' initial motivation in online L2 learning.

The "PPT reading" teaching style discouraged the learner to continue learning with high expectation on the course while the learner was able to carry on learning because of strong external influence (i.e., external-regulation (exam preparation)). To give an example, one of the online course designs integrated an external stimulus design by encouraging learners to keep "Check in (in Chinese "Da Ka" (打卡)) for ninety days in order to retrieve advance. The financial incentive indeed attracted learners to persist on learning at the beginning of the course, whereas it later made learners merely learn for the money rather for learning L2 per se. Triggered by the financial stimulation design, instead of following the internal desires (i.e., IM-knowledge), the participant switched to rely on a rather completion-oriented motive to support her learning in the rest course.

Learners' internal desires were not sustained while the external influences tended to be stable and motivate learners throughout the courses. Facing increasing language learning difficulties on the online courses, internal desires such as IM-accomplishments, entertaining cultural interests, and a way of thinking in another language were not adequate to help learners overcome the hindrance to maintain learning behaviors. However, with external influences such as EM-external regulation and major-related accountability, learners were motivated to continue learning despite the discouraging online course design features like slow instruction pace, "PPT reading" instruction, and inappropriate difficulty levels (either too shallow or unmatched with learners' proficiency level).

Apart from that, internal desires, such as being more like a native speaker (in Chinese "地道") and entertaining cultural interests drove learners to expect a social connection with others during learning. However, online course design with social needs in nature turned out to have negatively mediated the relationship between L2 learners' motivation and SRL for social interaction. For instance, a lack of individually communicative opportunities with instructors was closely related to learners' reluctance in participating online interactions. A larger size of social learning group generated the sense of distance for learners which could indicate less sense of relatedness in the community (Deci & Ryan, 1985). It hence discouraged the learner from interacting with others. This resonated with Kim (2013) who indicated a negative influence of large sizes on students' interactivity in the group. Besides, learners' expectation of a study partner to monitor and encourage their learning were not met

from the side of course providers. A negligence of learners' needs of external influences on scaffolding their learning partially led to learners' unsuccessful persistence in learning nevertheless.

Li (2016) indicated that both ideal and ought-to L2 self sustained over a three-months research period. On the contrary, Nitta and Baba (2015) indicated that learners' ideal L2 self evolves under co-adaptation over a one-year study in an EFL classroom context. Previous research (Fandiño et al., 2019) also found that learners' L2 motivation tended to be a complex process which was determined by various external factors. In the current study, learners' extrinsic motivations were shown as a strong and stable role in driving them to persist on learning while learners' intrinsic motivation was not sustained due to the designs of the online language courses. Besides, Wang and Zhan (2020) revealed that learners' L2 motivation was a significant mediator between online English learner beliefs and online self-regulation in English learning and between online English learning anxiety and online self-regulation in English learning. In this study, we also found that learners' L2 motivation played a mediating role in associating learners' SRL strategy use and the corresponding L2 learning performance.

6 Implications for Theory and Practice

The current study makes a contribution to the theory by integrating the framework combined by the SDT L2 motivation theory (Deci & Ryan, 1985), six dimensions of SRL (Dembo & Seli, 2008), and the instructional design principles (Lan & Hew, 2020) to online language learning contexts and by advancing the compounded framework through adding in emergent components. The integrated framework can elucidate how external factors such as online course design components relate to learners' L2 motivation and SRL strategy use. Moreover, the framework could also inform interventions for online L2 learning by modifying relevant components of the online language course designs, such as facilitating and stimulating more active interaction participation through smaller group and gamifying the activities.

7 Limitations and Future Directions

Although this study provides a qualitative perspective facing an array of prior statistic-based research, it owns its limitation for the self-report interview data per se. First, the participants were recruited based on convenient and snow-ball method while the research should have been set in a smaller and specific context in order to derive more contextualized and accurate results. Hence future studies could continue exploring how online language course design components function in learners' L2 motivation and SRL strategies in a more concrete context by

involving in multiple qualitative data sources for triangulation. Second, two participants Tang and Annie reported their online language learning experience that are related with target languages beyond the English language sphere. However, in this study, we did not differentiate the potential differences of learning different languages in online contexts. Thus, future studies could further study the relationship between language learners' motivation and their SRL taking account of multilingualism in online contexts. Third, future work could conduct longitudinal studies by conducting several interviews with each participant during the research period in order to trace their self-regulated online language learning at different learning stages. Fourth, we recommend future research to further explore how learners' age, gender, social background, and their language proficiency may affect their language learning motivation and self-regulated learning strategies in online learning contexts.

8 Conclusion

The components constituting online language course designs have played their roles in influencing learners' L2 motivation and SRL strategies in non-formal online learning contexts. To investigate how L2 motivation and learners' SRL strategies in this situation further influence learners' L2 learning performance, this study used in-depth interviews to analyze learners' own voices of their learning in a detailed manner by both considering the priori issues related to the topic and the emergent themes from the data. The results of the study showed that no matter intrinsic motivation-knowledge and extrinsic motivation-external regulation driving their online language learning, their motivation was changed by some online course design features. Learners hence self-regulated their learning by resorting to rather completion-oriented methods which however negatively mediated their L2 learning effectiveness.

Additionally, learners also reported that their willingness to participate in interactions either for social purpose or for the course contents in the learning community was highly connected with the group size. A group size that is too large will generate sense of distance which correspondingly prevented them from joining in discussions. The tasks involved in the online language courses lacked relevance to the video lectures and were too easy, which also discouraged learners from putting into efforts. However, learners' slack in doing tasks and interactive activities in turn reduced their L2 learning effectiveness.

Based on the results and discussions, an online self-regulated learning framework for second language is proposed by highlighting how online course design associates with L2 motivation and learners' use of SRL strategies. It is hoped that this paper will arouse more attention to be paid to how online language course design could better support learners' online self-regulation situating in online language learning contexts.

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An Empirical Study on the TEAMS Online Teaching Experiences at a University in Taiwan



Pei-Ying Wu, Kwan-Keung Ng, and Shao-Fu Li

Abstract Due to the COVID-19 pandemic in Taiwan since early 2020, most universities in Taiwan were required to shift from traditional face-to-face in-class teaching to online teaching to prevent virus infection among students. Chung Hua University (CHU) is one of the universities in Taiwan to adopt online teaching for all the faculties in the University. CHU adopted TEAMS as the online teaching platform. This study explores various perspectives and reflections of applying TEAMS as the online teaching platform in the teaching environment at CHU by conducting a qualitative survey with teaching staff and students from various faculties in the University. The research findings explain the perspectives of using TEAMS between faculties and students. Interaction is the most important factor in enhancing teaching and learning experiences based on teachers and student perspectives. Feedbacks also conclude experiences of using TEAMS are efficient and effective in teaching and learning for both faculties and students.

Keywords TEAMS · LINE · COVID-19 · Online teaching · Face-to-face teaching · Teaching and learning

1 Introduction

It has been widely addressed that the outbreak of COVID-19 has extremely affected learning and teaching in higher education institutions since the fall of 2019 (Zhao, Kung, & Cai, 2020; Xiong, Jiang, & Mok, 2020; Bao, 2020; Bryson & Andres,

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2020; Adedoyin and Soykan, 2020). During 2019 and 2020, the majority of higher education institutions in Taiwan suddenly have been required to shift from face-to-face teaching and learning in class to online teaching and learning by the Taiwan government in a short time, no matter whether teachers and students are ready or not (Xiong, Jiang, & Mok, 2020). For almost two years since the outburst of the COVID-19, and the pandemic of coronavirus diseases still are prevailing; thus, the implementation of online teaching and learning are continuous occasions in higher education institutions globally.

In comparison with other countries, the COVID-19 pandemic in Taiwan seemed to have been controlled well since 2019. Teachers and students in Taiwan were able to teach and learn in class mode as usual. Universities in Taiwan had also provided online teaching and learning training to teachers and students. Digital technology application awareness also increased in the universities. TEAMS was adopted to be the online teaching tool at Chung Hua University (CHU).

However, unexpectedly, the COVID-19 pandemic has outbreaks badly in Taiwan since May 2021; on 17 May 2021, the government announced that all teachers and students are stopped to go to the campus for preventing the virus infection among students from 18 May 2021 (Ministry of Education of Taiwan, 2021). Teachers and students are forced to shift from face-to-face in-class teaching and learning to entire online teaching and learning. In comparison with other countries, absolute online teaching and learning in Taiwan are in the beginning stage. Teachers may know about online teaching, but they may not have practical experiences. The online teaching experiences in other countries afford us lessons that merit attention. Bryson and Andres (2020) suggested that new teaching approaches emerge; all teachers will have to alter how they facilitate learning outcomes in this uncertain COVID-19 period. It may be an exciting opportunity for some teachers to change existing practices, but this may be challenging for most teachers in Taiwan. Thus, this paper aims to demonstrate the differences between various perspectives and reflections of applying TEAMS as the online teaching platform in the teaching environment at CHU by conducting a qualitative survey to the faculties and students across different departments regarding their teaching and learning experiences and feedback. It also provides unique records of this uncertainty period in higher education institutions during the COVID-19 pandemic in Taiwan for other overseas universities' references.

2 Literature Review

Along with the development of the times and the rapid development of science and technology, much state-of-the-art technology has been developed and invented new ways in the learning and teaching scenarios (Xiong, Jiang, & Mok, 2020; Mwandosya & Montero, 2017; Oyelere, Suhonen, Shonola, & Joy, 2016; Evans, 2007; Wallace, 2003). Digital technology teaching and learning is no longer a novel phenomenon; it has been accompanying higher education institutions for several years already (Adedoyin & Kopp et al., 2019; Leszczyński et al., 2018; Soykan,

2020). Mobile education, or mobile learning (m-learning), has transformed traditional face-to-face teaching to e-learning, making teaching and learning more flexible anywhere and anytime through mobile devices (Mwandosya and Montero, 2017, p. 882). Many researchers agree that the online teaching model has increased higher education student numbers worldwide; it also opens up new markets across countries (Folley, 2013; King, 2010; Hislop, 2009; Reinhart, 2008; Dykman & Davis, 2008a; Cuellar, 2002). Thus, this paper will demonstrate the differences between various perspectives and reflections of applying digital technology as the online teaching platform in the teaching environment at CHU. The application of digital technology in higher education, particularly at CHU, will be discussed, and the concept of education will be illustrated.

3 Digital Technology Application at CHU

3.1 CHUMoodle Online Platform

The University provided an e-learning platform in CHU, namely CHUMoodle (<https://elearn.chu.edu.tw/>), to both teachers and students since 2000. Teachers apply the platform to upload the teaching materials, and students are required to submit their assignments to and download learning materials from the platform. It is provided as an asynchronous learning approach to students. Teachers and students can leave their feedbacks/comments anywhere and anytime, and this platform also records the teaching and learning recordings during the studying period. Furthermore, Zuvio IRS is another platform provided with CHUMoodle at CHU to both teachers and students. IT Centre embedded all courses to CHUMoodle and Zuvio IRS at the beginning of every semester (Fig. 1).

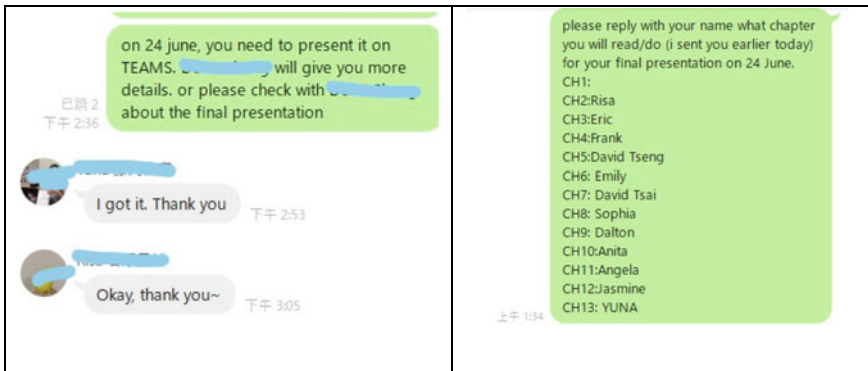
3.2 LINE Application

In addition to the above platform, both teachers and students also use an additional social media tool, LINE, as the daily communication platform. The LINE application is widely used in Taiwan. It facilitates online communication among people easily and quickly. For example, teachers can announce the assignment details, such as the submission date and format, immediately on the LINE application. Students can ask questions and may get a reply from teachers promptly. It helps teachers to manage class and communicate with students easily (Fig. 2).



Source: From the authors at CHU

Fig. 1 HUmoodle and Zuvio IRS examples



Source: From the authors at CHU

Fig. 2 The LINE APP example

3.3 TEAMS Application

3.3.1 ZOOM Introduction

Zoom is defined as “move or travel very quickly” based on the Oxford dictionary (Hawker & Waite, 2007, P. 1060). Zoom helps businesses and organizations

bring users to meet together in a frictionless environment without travel physically. Zoom provides an easy and reliable cloud platform for video, voice, content sharing, and chats across mobile devices, desktops, telephones, and room systems. Zoom is publicly traded on Nasdaq (ZM) and headquartered in San Jose, California (Zoom Video Communications, Inc., 2019). Since the technology development, Zoom is also developed as one of the fast communication tools through the internet, and nowadays, it gradually replaces the traditional telephone. Users can use it to communicate worldwide. Notably, during the COVID-19 pandemic period, it has become an essential tool for people to contact each other through the internet without a face-to-face meeting. Carter (2020) indicated that Zoom stands out as a pioneer in the video first collaboration culture. Zoom offers unparalleled simplicity, designed to drive the adoption of a video first culture. Users can join a meeting anywhere, from any device, and access video for internal and external communications. Features include (Zoom Video Communications, Inc., 2019):

- HD Video and Audio
- Support to up to 1,000 video participants
- Up to 49 videos on the screen
- Advanced Encryption for Chat
- Streamlined calendaring with integrations to Outlook and Gmail
- Role-based security
- Screen sharing and co-annotation
- Recording and transcription
- Team chat with groups
- Searchable history
- File sharing.

3.3.2 TEAMS Introduction

Carter (2020) mentioned that Microsoft Teams is probably the most popular business collaboration tool on the market. It sets it apart from the crowd because it works so well with the rest of the Microsoft Stack. Users can launch meetings from Outlook or Exchange Calendar and work together on documents more accessible.

Microsoft is constantly rolling out new features to make the Microsoft Teams experience more engaging too. For instance, users can access tools specifically for first-line workers or make background blur in videos to reduce distractions in the meeting room environment. TEAMS is also accessible across any device, offering a seamless experience wherever the users are.

Features include (Microsoft Team, 2021):

- Full integration with Office 365
- Video conferencing with background blur
- Excellent audio with in-line transcription
- File and screen sharing
- Instant messaging one-to-one and in groups

- Fully searchable conversational channels
- Access from all devices
- End-to-end security
- Endless bots for integrating extra functionality
- Tabs to make finding information easy
- Recording.

Eventually, TEAMS was selected as the online teaching tool at CHU. The main reasons for choosing TEAMS as the online teaching tool at CHU are price, functions, and government policy. Firstly, although both tools are free if users only use basic functions, users still need to pay a fee to Zoom in early 2020 if their meeting lasts for over 45 min. Simultaneously, Microsoft has authorized office 365 to many universities in Taiwan, and CHU is one of them. CHU has a long-term collaboration with Microsoft. In 2020, TEAMS was free to use in the University when compared to Zoom. Secondly, ZOOM had limited capacity and time compared with TEAMS. Zoom only allows a maximum of ten participants and limits to 40 min meetings in the free version. The main reason is that Taiwan's government has banned zoom due to security concerns (BBC News, 2020; Yang, 2020). Education institutions are not allowed to use Zoom for online education in Taiwan. Based on the above considerations, CHU finally selected TEAMS for the online teaching tool in the University.

4 Interaction with Students

University education is implied that mature students obtain and develop in-depth knowledge, and as an outcome, students will receive the degrees. The progress required the students' and faculty's attitude and motivation. Students need to learn efficiently and effectively, and faculties need to attract their learning motivations.

It has been widely addressed that the interaction between teachers and students in teaching–learning progress is of utmost importance (Froment, GARCÍA GONZÁLEZ, & BOHÓRQUEZ, 2017; Bouhnik & Deshen, 2014; Thoonen, Slegers, Peetsma, & Oort, 2011; Northcote, 2009; Wallace, 2003; Pianta, Stuhlman, & Hamre, 2002; Cooper & McIntyre, 1994; Moore, 1989). Typically, this kind of interaction has happened in the classroom and face-to-face circumstances, or it could be explained as the absence of real-time interactions (Bryson & Andres, 2020; Joshi et al., 2020; Adedoyin & Soykan, 2020; Murphy et al., 2011). Students may have good performances such as good grades, good skills competence, and good study behavior if they have a good interaction with teachers.

Although CHU has been introducing online teaching and learning, it has resulted in panics to teachers and students in teaching and learning. However, CHU has been introducing online teaching and learning training for a few years already. In addition to face-to-face interaction between teachers and students in the classroom, following the rapid development of technology, more technology tools have been

applied in the teaching and learning progress, particularly under the COVID-19 outbreak period globally. In CHU, the majority of courses are taught in a classroom-based model. However, since 17 May 2021, the COVID-19 pandemic outbreak suddenly, the government announced that all educational institutions must conduct entire online teaching and learning to prevent the virus infection among students. In order to provide some insights into using online teaching and learning, this research will conduct a qualitative survey with the teaching staff and students from various colleges to explore multiple perspectives and reflections of applying TEAMS as the online teaching platform in the teaching environment at the University.

5 Research Methodology and Design

As aforementioned, this research explores perspectives and reflections of applying TEAMS based on teachers and students at CHU. The study conducted a qualitative survey with teachers and students across different colleges. The survey aims to determine what the teachers and students are concerned about using TEAMS as the teaching and learning tool instead of the traditional face-to-face teaching and learning style.

The questions for both teaching staff and students are:

1. What is the comparison between “TEAMS online teaching/learning platform” versus “traditional face-to-face teaching” in the class?
2. Do you think the TEAMS online teaching platform would facilitate the students’ learning efficiency and effectiveness?
3. Do you believe the TEAMS online teaching platform would help learners improve their study behavior, learning concepts, and skill competence?
4. Do you believe the TEAMS online teaching platform would motivate and facilitate the learning interests of students?
5. Any other suggestions or comments on the TEAMS online teaching platform?
6. Which online teaching platform would you prefer? Why?

Using a structured questionnaire that contained the above questions for overall qualitative interview, the questionnaire was sent via google form across the various colleges to faculty, and ask faculty to invite potential students to fill out the questionnaire from May to June 2021. The questionnaire is anonymous.

6 Findings and Discussions

Eighteen faculties participated in the interview; fifteen were from different colleges, including the College of Tourism, the College of Management, the College of Architecture and Design, the Centre of General Education, and three from the IT center.

Table 1 Number of participants

	Faculty	Students
Number of participants	18	28

Meanwhile, eighteen teachers and twenty-eight students were invited to the interview who were across different colleges at CHU (Table 1).

6.1 Responses to Question 1

6.1.1 Responses from Teachers

All teachers agreed that online teaching is a new trend of teaching in the current situation. Notably, in May 2021, the Covid-19 pandemic was suddenly and rapidly spread in Taiwan. From 17 May 2021, all students from different education institutions have stopped going to classes. Academics were forced to use online instead of traditional classroom teaching in a very short time. Teachers responded that even though they knew some digital online tools since the COVID-19 pandemic spread worldwide in 2020, they did not expect to use online teaching entirely in their teaching careers. Anyway, they have been using the LINE to communicate with students daily, and they required students to submit assignments via the CHU digital platform, namely CHUMoodle. They interacted with students in the classroom and applied several digital tools such as IRS, Kahoot, Youtube videos as additional teaching tools. They observed students face-to-face in the classroom to adjust their teaching strategies. By doing so, they believe the interaction with the students is effective and positive.

However, since May 2021, in a very short period, teachers have been forced to teach via TEAMS in CHU due to the fast COVID-19 pandemic spread in Taiwan. Teachers expressed that they were not ready to use complete online teaching mode even though CHU has provided TEAMS training since 2020. Teachers addressed that the difference between “TEAMS online teaching platform” and “traditional face-to-face teaching” in the class is the digitalized strategy on teaching and learning. It means that teachers are concerned about the interaction with the students via the digitalized teaching strategy. For example, teachers may interact with students by asking questions and observing in the classroom by face-to-face mode. But now, teachers and students are behind the internet. Teachers and students are required to use TEAMS, which they may not be familiar with the functions. Twelve teachers agreed that it is an excellent opportunity to apply and practice the TEAMS for now. Online teaching mode may be a teaching trend in the future. However, six teachers replied that it is heavy work for them to transfer traditional face-to-face teaching to online mode. The teaching materials are necessary to be re-designed, and they need to learn TEAMS in a very short time. TEAMS has been applied in online teaching for only two weeks in Taiwan; most teachers prefer traditional face-to-face teaching

in the class. They said it is easier to observe students' learning attitudes and interact with students through the face-to-face teaching model.

6.1.2 Responses from Students

On the other hand, almost 50% of student participants replied that they like online learning. They prefer to use TEAMS to study. They said that studying is more comfortable when they stay at home, and they do not need to go out to the faraway classroom. In addition, students said they are encouraged and willing to ask questions by typing queries online. As at the school, they do not dare to ask questions in person actively. Remarkably, the recording function of TEAMS is also beneficial to them; students can review class content after the class.

Although half of the students like online learning, another half of the students prefer to study face-to-face in the classroom, the reasons are: it is easier to interact with classmates and teachers. They replied that they prefer to learn in the class as they would concentrate more on studying and interacting with teachers and classmates. Some discussions and practical class activities are easier to be conducted in the classroom.

Both teachers and students agreed that TEAMS is a new teaching tool in teaching and learning. However, both participants mentioned that they all need to be familiar with the latest technology; more online teaching and learning practices are necessary as new technology is convenient in teaching and learning. Still, the actual interaction is less than in the class.

6.2 Responses to Question 2

6.2.1 Responses from Teachers

There are three perspectives from the teachers' responses. From the first perspective, some teachers just started to apply TEAMS in their teaching. They are not used to this tool in comparison with in-class teaching. Teachers are still learning it, and they are still observing students for their learning efficiency and effectiveness. For the second perspective, some teachers mentioned that they were new to the TEAMS tool in teaching, and they believed that more online practices would make perfect. Currently, there are many digital learning online workshops/training provided in Taiwan due to the COVID-19 pandemic spreading rapidly since May 2021. Both teachers and students are forced to stay at home, teach from home, and learn from home. They are forced to learn new technology either passively and actively. Some teachers also mentioned that some students are willing to ask questions by using TEAMS. Students just typed the questions on the TEAMS, and teachers answered them. By doing so, students are more actively learning online than in the class. In the meantime, teachers noticed that using TEAMS accompanying the Microsoft

Office application, such as PowerPoint to explain the subject theory concept, would be similar to classroom teaching. However, for the third perspective, some teachers complained that TEAMS is not helpful. The reason for it is that these teachers teach practical courses such as product design, drawing, etc. They need to give theory lectures followed by practical training as the class activities and grade evaluation.

6.3 Responses from Students

From student responses, almost 50% of students agreed that TEAMS would facilitate their learning efficiency and effectiveness. Students stay at their places which they feel comfortable. They can learn online without going to the classroom, and they will follow teachers teaching content and activities to study. They also mentioned that they could use the internet to search the concept they could not understand during class time. TEAMS also provides the video recording function, and it will help students review the class after class time. Students said it is a benefit. However, some students indicated that they would not participate in online activities during class time. They just close the webcam and voice but keep their status online for the attendance records because they are not interested in the teaching subject.

6.4 Responses to Question 3

6.4.1 Responses from Teachers

There are three main points from teachers' responses. The first one is that students will be distracted at home rather than at the classroom using TEAMS. Teachers also indicated that they could not observe students' study behaviors online directly compared to classroom-based teaching. The second one is the heavy workload on teachers' shoulders. TEAMS teaching for teachers currently suggested that teachers need to learn new digital technology to transform their previous teaching content. The third one is that students' learning effectiveness is still under observation, as for both teachers and students, TEAMS is a new tool. Teachers suggested that both teachers and students are required to learn new digital technology to improve teaching and learning interaction.

6.4.2 Responses from Students

In terms of study behaviors, half of the students agreed that TEAMS would facilitate their self-learning ability of learning theory concepts. They also said that they have more focus on studying when they stay at home. In addition, students also indicated that it is crucial to learn new technology in the current environment. However, another

half of students replied that they prefer to study in the classroom. They want to interact with teachers and classmates in the classroom. For some students, there are no differences between online learning or in the classroom. It depends on students' self-learning ability. They also indicated that it is necessary to be led by teachers physically in the classroom for some practicum courses such as cooking.

6.5 Responses to Question 4

6.5.1 Responses from Teachers

All teachers have the same belief that TEAMS can motivate and facilitate students' learning interests. Teachers may apply new functions of TEAMS to design their teaching strategy in order to interact with students and improve students learning motivations. However, for short-term concerns, both teachers and students must learn the new technology tools to process the teaching and learning process.

6.5.2 Responses from Students

Students replied that it, again, depends on the course subject. It will motivate and facilitate students' learning interests if they are interested in the subject, and they do not care whether it is online or in the classroom studying.

6.6 Responses to Question 5

6.6.1 Responses from Teachers

In comparison with the influences of the COVID-19 in other countries, students could still attend the class in person in Taiwan at the early stage. However, as the coronavirus pandemic has outbreaks badly in Taiwan since May 2021, all teachers agree that TEAMS is a useful online teaching tool. In order to improve proficiency, not only teachers should learn TEAMS, but also students need to learn it. In addition, as mentioned previously, teachers and students are forced to stay at home and learn, teach from home from 17 May 2021 (Ministry of Education of Taiwan, 2021). Teachers are still learning the TEAMS to continue their teaching in a short time. Academic colleagues need more support from the University regarding the online teaching approach and online teaching tools to improve their online teaching ability.

6.6.2 Responses from Students

Students suggested that the familiarity with the TEAMS system will assist both teachers and students to encounter the current uncertainty of the teaching and learning environment at CHU.

6.7 Responses to Question 6

6.7.1 Responses from Teachers

As mentioned previously, TEAMS is used at CHU as the online teaching tool for all teachers and students according to the instruction of the Taiwan government. All teachers have used TEAMS as CHU required all faculties to learn it due to the COVID-19 impacts; however, several teachers responded that they have been using ZOOM after work. At the beginning of selecting ZOOM or TEAMS as the primary online teaching tool at the CHU in 2020, the teachers and the IT center staff need to understand the functions and details of both devices. However, since May 2021, due to the rapid COVID-19 outbreak, all teachers and students are forced to stay at home. Some other online teaching platforms are to be applied across different universities in Taiwan, such as Google classroom, google meet, cisco Webex meetings, etc. Since 17 May 2021, teachers are forced to apply completed online teaching in a short period; teachers in CHU must learn TEAMS before they learn other online teach tools, according to the reply from teachers.

6.7.2 Responses from Students

Students have more flexibility and alternatives to use digital tools for their studying. Some students answered that they have to use TEAMS for a class studying at CHU, but they may use ZOOM to communicate with their family if they are overseas students. They also said some teachers use the LINE APP to communicate with them, making it easier to communicate with teachers and classmates. Nevertheless, similar to teachers' responses, for the current situation, students must learn TEAMS for their studying at CHU before they adopt other online studying tools.

7 Recommendations

This study aims to demonstrate the differences between various perspectives and reflections of applying TEAMS as the online teaching platform in the teaching environment at CHU. Regarding the research findings, two recommendations are

proposed for teachers and students for the current university situation in Taiwan, i.e., developing hard-power learning ability and soft-power learning ability.

7.1 Development of Hard-Power Learning Ability

The outbreak of the COVID-19 pandemic has badly affected all environments since 2019; however, it can be seen as an opportunity to develop new technology skills in teaching and learning. Traditionally, face-to-face in-class teaching is the principal teaching approach; teachers and students meet on specific dates and times at a particular place to process the teaching and learning process. Teachers can physically observe students' reactions and adjust their teaching strategy in the classroom to ensure student's learning outcomes. However, due to the COVID-19 pandemic influences and thanks to the new development of technology in education, these in-classroom interactions have to shift to online. The teaching and learning process relies on the internet and digital communication. Teaching online by conducting technology tools have become the future development trend (Xiong, Jiang, & Mok, 2020; Adedoyin & Soykan, 2020; Kopp et al., 2019; Leszczyński et al., 2018; Mwandosya & Montero, 2017; Oyelere, Suhonen, Shonola, & Joy, 2016; Evans, 2007; Wallace, 2003). Thus, learning technology tools for both teachers and students are becoming vital.

In addition, learning online technology tools, teachers also need to customize their teaching strategies from face-to-face in-class mode into online mode. As mentioned, CHUMOODLE and ZUVIO IRS are the e-learning platform at the CHU for decades; both teachers and students are familiar with these online tools. Teachers upload their teaching materials to the CHUMOODLE, and students are required to submit their assignments to CHUMOODLE. During the off-class time, teachers can arrange to examine questions on the CHUMOODLE or ZUVIO IRS platform to students for additional asynchronous learning. Meanwhile, the LINE APP has been widely used in Taiwan. Some teachers also apply the LINE APP to manage the class. These technology tools, i.e., CHUMOODLE, ZUVIO IRS, LINE APP, are well used by teachers and students in the class. For TEAMS learning experiences, both teachers and students are not expected to shift the entire teaching and learn online on TEAM so quickly and suddenly. Undoubtedly, TEAMS can be an advantage for teaching and learning in the future if both teachers and students are more familiar with the functions and applications of TEAMS.

7.2 Development of Soft-Power Learning Ability

The lack of self-discipline has been addressed as an online learning challenge for students (Xiong, Jiang, & Mok, 2020; Tekkol & Demirel, 2018; Song & Hill, 2007). As mentioned, university education implies that mature students obtain and develop

in-depth knowledge, and as an outcome, students will receive the degrees. Students at the university level are required self-discipline. However, due to the sudden and rapid COVID-19 outbreak in Taiwan, teachers and students are forced to shift from face-to-face in-class teaching to online teaching and have to accustom the online learning in a very short time. Students went to the classroom and interacted with teachers and classmates routinely. Unexpectedly, this routinely studying mode has been changed to online learning mode. Some unruliness students may be out of control. They may oversleep and get up late and miss the class. As a result, they may not learn efficiently and effectively as they did in the classroom. Learning motivations may assist this situation; teachers are suggested to develop a good relationship with students (Cooper & McIntyre, 1994; Northcote, 2009) and apply some technology tools such as LINE APP to interact with students. From the student perspective, the University is suggested to offer self-disciplinary training to students and coach them to accustom online learning and digital communication with their teachers when they are restrained their study at home.

8 Limitations and Further Research

Technology tools in teaching and learning are now enhancing day by day in cities and campuses worldwide. COVID-19 pandemic may be an opportunity for changes of the university education. It is used to enhance interaction between teachers and students, and most online tools have been applied depending on users' habits. TEAMS has been applied in CHU as the primary online tool for both teachers and students. This study focused on the perspectives of using TEAMS from teachers and students at CHU. It mainly conducted a qualitative survey to both teachers and students due to the unexpected teaching and learning mode being changed from face-to-face to completed online mode in a short time. The limitations of the study are limited in sample size; the interviews with teachers and students were comparably small and the study did not have a chance to evaluate all the online learning tools with the participants. However, it provided insights into using TEAMS online tools experiences and unique recordings from both teachers and students during the COVID-19 pandemic.

In order to further explore the strategies to enhance the online teaching effectiveness, it is suggested to conduct a quantitative survey with teachers and students from different departments or even other universities regarding their perspectives and reflections on various online teaching tools adopted in higher education institutions.

In addition, the following recommendations for the future of online teaching and learning are proposed after the pandemic:

- Retraining teachers: with the current online tools, teachers must actively participate in various training courses to hone their teaching skills.
- A mix of online tools applications: for specific needs, such as in the teaching of architectural design, the Jamboard function of Google Meet is often used to communicate the manuscript design, and Microsoft Teams is also used to maintain a smooth video to observe whether all students maintain a normal class status.
- Advocacy for students: whether the student’s online equipment is complete, whether the application skills are appropriate, etc., must be confirmed.
- Scoring criteria for online assignments: Online assignments should be measured rigorously.

9 Conclusion

This paper raises the importance of technology application in higher education institutions and its future development trend. Even though the COVID-19 pandemic has had a tremendous impact on industries and education institutions worldwide (Yang, 2021; Thoonen et al., 2010; StackShare, Inc., 2021; Kent, 2021; Hong, 2021; Fasciani et al., 2020; Cowan et al., 2013; Bolliger and Wasilik, 2009; Bach et al., 2007), it also brings new technology development opportunities. Digital education technology has been applied in the education environment nowadays. Many online tools have been widely used in teaching and learning in higher education environments worldwide. Since May 2021, both teachers and students are suddenly forced to teach and learn completed online in a very short time in Taiwan. According to the survey outcomes, both teachers and students indicated that applying technology tools in teaching and learning will become a future development trend. TEAMS is also confirmed as the helpful online teaching and learning tool at CHU based on teachers’ and students’ perspectives and reflections.

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From Big Data to Blockchain: Promises and Challenges of an All-Encompassing Technology in Education



Jae Park

Abstract Blockchain is regarded as the next technology-mediated mega-transformation after the ongoing ‘Google’s System of the World’ (Gilder, 2018). This chapter critically reviews the extant studies and theories on blockchain technology and its influence on education. Blockchain in education aims to enhance objectivity, validity and full control of a specific information without being compromised by economic, health or political instabilities. Education blockchain promises, among others, a greater control over financing and investing in education, implementing instructional projects, a certification system and learning. Blockchain with its distributed ledgers would set the standards to ‘crypto-instruction’ and ‘crypto-educational administration’ that would be recognized across organizational or national borders, yet, neither transparent nor clearly sustainable. Therefore, it is argued, blockchain technologies in and for education are a credible augur of an upcoming paradigm shift in human experience, yet, they are no exception to the general principle of magnification and the reduction of technology (Ihde, 1993).

Keywords Education blockchain · Distributed ledgers · Crypto-instruction · Blockchain sustainability · Blockchain collective common · Educational administration

1 Introduction

Blockchain is a Distributed Ledger Technology, which has been identified as a technology-mediated socioeconomic system taking over the era of Net Neutrality, Big Data, global market capitalization oligopoly and, broadly and aphoristically, ‘Google’s System of the World’ (Gilder, 2018). This chapter discusses the actual and potential impacts of blockchain technology on education, that is, blockchain

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as a ‘New Paradigm for Digital Communication and Learning: Changes and Challenges,’ directly addressing the main theme of the 2021 Conference of the Hong Kong Association for Educational Communications and Technology (HKAECT).

As a time-honored social institution for knowledge transfer and a field of study, education has consistently been swift in adopting technologies from the industrial, financial and other sectors including the military. Education is undergoing a honeymoon period of Big Data, mass social media, STEM curriculum and data mining/analytics with subservient technologies such as Artificial Intelligence and Machine Learning. These are coupled, in turn, with refurbished teaching and assessment practices such as flipped classroom and technology-assisted evaluation. Some of these have been problematized, for example, Big Data for its critical issues of veracity (validity) and value (purposefulness) that are surreptitious as well as culturally invasive in the ways of obtaining and processing data such as mass surveillance, which pose tough ethical questions (Park, 2019).

Although the frontiers of veracity and value of Big Data are far from being clearly demarked, Big Data has been consistently relying on the principle of Net Neutrality (Park, 2021). It might not take long, however, to see an end to it. In the book *Life after Google*, George Gilder (2018) argues that after the ongoing era of Big Data and highly accessible Internet yet controlled and exploited by ‘big tech’ companies such as Google, blockchain would be the next technology-mediated socioeconomic mega trend. Blockchain is the strongest candidate to dominate new security structure of the Internet, which allows to keep for oneself and explicitly permitted others, a specific information with value. Blockchain would ultimately safeguard the integrity of that valuable information by saving the owners from external interferences and contingencies such as disclosed identity, sociopolitical instabilities, disruption of her/his privacy and service charges by third parties (e.g., Google Play’s apps and in-app purchases charge 30% of the price the customer pays for billing service). Blockchain technology serves the purpose by documenting human acts and keeping information in blocks/ledgers that is continuously updated and verified peer-to-peer, again, without the intervention of third party authorities such as the government and companies like Facebook and banks.

This chapter explores blockchain technology and its impacts on education. It draws on the extant reports and research by those who wish to harness its potentials for education, from academics to international agencies in charge of monitoring education. The chapter starts with a general introduction to blockchain technology by arguing that its application in real life is recent, not yet widespread, and its evolution, unpredictable. It will be followed by a review of the extant literature on the actual use and potentials of blockchain technology in and beyond cryptocurrencies. The next section will be devoted to the potentials and actual applications of blockchain technology in and for education. The chapter ends with a twofold elaboration on why blockchain technology enjoys a sluggish rate of adoption in the field of education.

Blockchain technology was originally intended for attesting the ‘who,’ ‘what’ and ‘when’ of digital documents in 1991. Left unused for years, an incognito person with the pseudonym of Satoshi Nakamoto applied it into the first digital cryptocurrency in 2009—the *Bitcoin*. A decade into its application as cryptocurrencies, which are

now counted by thousands, blockchain has already proven itself to be a technology that allows to secure digital data controlled by its users. Even though its first broader application in cryptocurrency is considered as being technically secure, blockchain is subversive to the traditional financial system in the sense that it is not subject to third party scrutiny/attesting by financial institutions such as banks, credit card corporations, the Society for Worldwide Interbank Financial Telecommunication (SWIFT) system and state financial regulatory authorities.

Gilder briefly describes blockchain as:

A database, similar to a cadaster of real estate titles, extended to events, covenants, patents, licenses, or other permanent records. All are hashed together mathematically from the origin of the series, each record distributed and publicized on decentralized Internet nodes (2018, p. 241)

For the purpose of the present chapter, a discussion about the impacts of blockchain on education, a blockchain Block consists of: (1) The Data—its particulars and the Nodes taking part; (2) the Hash of the Block that is an identifier that gets changed with every change in the chain; and, (3) the Hash of the previous Block that constitutes a full logbook. An exception to the latter is the ‘Genesis Block’ since it is the first born.

Blockchain is antithetical to the Big Data due to its mode of creating, owning and sharing a dataset, for example, it is utterly against the Net Neutrality doctrine as it is enclosed and not free of cost at all. The core of blockchain technology is its heavily encrypted ‘Open Ledger’ or ‘Distributed Ledger’ (among a set or limited number of Nodes) through which, the veracity of a dataset is transparent to all Nodes within the same chain, and the latter is verified in a decentralized manner. For this, there must be a ‘proof-of-work’ or ‘mining,’ which is the crucial task of verifying the validity of an incoming new Block by the ‘blockchain miners.’ A ‘proof-of-work,’ also known as ‘mining,’ requires high speed and high energy-consuming processing and computing power, a resource-intensive service that has to be rewarded. A ‘proof-of-work’ task in the *Bitcoin* takes about ten minutes and blockchain miners are rewarded with coins. As it will be detailed later, mining is one of the biggest technical challenges for applying blockchain in education.

Another interesting pre-determined arrangement over the process is ‘Smart Contract’ by which, under certain conditions stipulated digitally, specific procedures are executed by the power of peer-to-peer agreement. *Ethereum* is, for instance, a blockchain computer network platform that materializes smart contracts using a unique computer language (*Solidity*).

Although information such as smart contract and proof-of-work seem to be remote to the field of education, the focus of this chapter, these basic features are crucial for understanding and assessing the impacts of blockchain technology on education as will be argued later on.

2 Blockchain Technology in Industries

The ultimate purpose of blockchain technology is avoiding uncertainties inherent to the authenticity of identities of people and the accuracy of shared information. This uncertainty avoidance is achieved by blockchain technology with shared information on virtual identity and transactions that are transparent to all parties involved yet, at the same time, meticulously veiled with powerful cryptography.

The number of potentially beneficial areas of social and economic life to which blockchain technology can be applied is daunting. Such potentials become materialized only when the users are able to diversify applications and move on from the current Blockchain technology 1.0 to the next level (Chen et al., 2018; Swan, 2015):

Blockchain technology 1.0	Peer-to-peer payment system
Blockchain technology 2.0	Stocks, bonds, loans, smart property and smart contracts
Blockchain technology 3.0	Government, health, science, literacy, culture and art

With the main focus on financial applications, Blockchain technologies 1.0 and 2.0 involve an explicit act of dodging regulatory interventions or refereeing by traditional third parties such as the state, banks and other international financial intermediary services. For example, to be legit, smart property's transfer of a real estate ownership would always be publicly registered and subject to stamp duties in situ. In contrast, Blockchain technology 3.0 is distinct due to its (1) applying the technology in areas beyond market capitals and finance, and, (2) 'non-peer' parties such as the state can partake in the creation of a distributed ledger as the genesis block or play a role as a Node, for example, in public service governance.

The potential areas for blockchain technology application are very broad, however, its actual use is still predominantly in finance (Gatteschi et al., 2020). Yet, even in finance, blockchain technology is migrating from 1.0 to 2.0, for example, when exchanging cryptocurrencies into and from Fiat Money (government-issued currency) or gold. As shown in the cases of *Gnosis*[®] and *Augur*[®], when market predictions or oracles are accurately recorded in shared ledgers, they are rewarded monetarily. Other current applications of Blockchain technology 2.0 are in smart contract-based pension fund transfer services and money lending (Gatteschi et al., 2020, p. 98).

A non-financial use of blockchain technology is notary or comparable certification services that require arbitration in intellectual properties, copyrights and their licensing (Gatteschi et al., 2020). As alluded earlier in the history of blockchain technology, such certifications and time stamping were the originally intended purpose of blockchain technology. Through smart contracts, it is possible to execute, for example, a last will with detailed conditions of inheritance transfer. Furthermore, public legal records such as marriage and divorce cases can be managed with blockchain. Smart contracts can also be used for real estate management, property transfer and pay-per-use as well as peer-to-peer insurance.

Blockchain technology is used not only for personal data management such as the authenticity of identities and personal information sharing but also by industrial sectors such as for construction logbooks, engineering works such as aviation and trades including, for example, tracking commodities such as diamonds, drugs and leisure event tickets (Gatteschi et al., 2020, p. 100). This has implications in education, for example, vocational and technical education, engineering education and training in trade and commerce. Used wisely and uprightly, blockchain technology can improve or resolve some dated side effects of human activities such as child labor and fair trade.

Blockchain technology could surely be applied for the benefit of the public and collective interests such as personal information management (e.g., immigration status), ownership (e.g., copyrights and housing) and payment records (e.g., tax and through smart contracts reducing the defaulting rate of bad loans). Blockchain technology applications that have already been tested in other fields can be used in the administration of the state and localities (Gloerich et al., 2020), which includes the education sector. Thus, an area of application still to be tested in real life is in the one-man-one-vote democratic electoral system with its ledger that is transparent to all political parties and constituencies. Similarly, blockchain technology can be used, tamper proof, in the administration of tax, mortgage, supply chain, delivery services, shipping, postal service and audits. It is not unthinkable, therefore, a few years from now, that undergraduate and postgraduate courses on blockchain could become a standard curriculum content for degrees in the areas of public administration and political science.

The ongoing (as of July 2021) research and development of *e-CNY* of China partly aims at controlling cryptocurrencies, yet, it might need to use blockchain technology in order to implement it (PBOC, 2021). It will probably be tested with international users by the Chinese state around the Beijing Winter Olympics in 2022. Instead of cryptocurrency, then, the *e-CNY* could be a state-regulated digital currency that could be relying on some Blockchain technology 2.0.

Another intensively reported area of blockchain technology application is in the healthcare system, both private and public. The healthcare system is one of the hardest fields where blockchain technology is being tested because it deals with problems that even money cannot completely solve—health threats and life quality. Traceability of health-related information is the main benefit of the blockchain technology in the field of public health. A meta-analysis of 197 studies identified five main application areas of blockchain technology in healthcare (Kassab et al., 2019): Managing and sharing healthcare records, medical supply chain, medical training and education, clinical research and even insurance claims.

Some other benefits of blockchain technology in healthcare are in the accessibility criteria of health records, transparency of health services, information security and better performance. There are also challenges of incorporating blockchain in healthcare, namely, (1) scalability and performance, (2) usability, (3) secure identification and, (4) lack of incentives and willingness to adopt blockchain technology (Kassab et al., 2019, p. 11). Blockchain technology is being used ‘medicines, medical

equipment, health supplies, besides reinforcing the value of health records and potentializing the ownership of the medical history to the patients through unified registers' (Kassab et al., 2019, pp. 12–13). At the individual level, sharing the medical record of a patient with her/his hash via smart contract provides clear-cut parameters for restrictions and access rights available to doctors and health professional across hospitals and even perhaps among nations in global health crisis such as the ongoing COVID-19 pandemic. Health wallet would be an added feature that can enable payments from hospital fees to the international purchase of vaccines. In drug administration, for example, pharmaceutical product distribution processes, from the producer to end users, could be better tracked by committing the involved parties to be responsible and accountable. In the future, blockchain could be a normal part of medical education, pharmacology students and nursing studies.

The most recent and people-oriented application of blockchain technology is for the socially responsible mode of production and crowd financing/accounting. This is distinctively a Blockchain technology 3.0, and it has been proving itself to be a driving force of future social organization. The crux of this blockchain is not the technology itself but its intended goals of social change and justice through peer-to-peer communication, autonomous organization and contribution to the globally distributed commons with shared innovative knowledge, resources and open cooperative economy called Commons-Based Peer Production (CBPP) (Bauwens et al., 2019). Blockchain technology is used to develop 'ecosystems of collaborators based on distributed ledgers' (Bauwens & Pazaitis, 2020, p. 10), which, in turn, let a grassroots network of people to monitor and develop, for example, transnational territories and wildlife species such as the Amazonian rainforest and the African elephants. Among the extant projects, we have the *GainForest* for the Amazon rainforest and the *Great Elephant Census* for the African wildlife monitoring (Bauwens & Pazaitis, 2020). Training in blockchain could be a compulsory subject in the future for students in environmental sciences and the lifelong learning of people who devote their lives for a sustainable world and nature conservation.

The foregoing discussion suggests that blockchain can serve as a tool to reify such post-capitalist socioeconomics despite the ongoing cryptocurrencies' strong orientation toward a distributed capitalism. It is for this reason that proponents and practitioners of the CBPP advocates for a post-blockchain era (Pazaitis, 2020, p. 2):

[Distributed ledger technologies] have challenged the core assumptions of the financial and monetary system, opening up a discussion where these matters become relevant for an increasing fraction of society. Now, an ontological shift is necessary to break the chains of open innovation through CBPP. Post-blockchain encapsulates such a vision of a blockchain-informed transition that is not necessarily blockchain-driven.

Unlike blockchain-driven cryptocurrencies such as *Bitcoin*, a blockchain-informed CBPP empowers the grassroots, for example, digital wallets allowing them to do payments and receive money without a domicile or bank account. This process of empowering has a precedence in some developing countries where the state grants house and land ownership through housing/land reforms (e.g., Peruvian squatter dwellers receive an address which turn them to be economically active; see

(Soto, 2002)). The difference is that a blockchain-informed empowerment does not need a state intervention.

The discussion in this section demonstrates a tension in the use of blockchain technology. On the one hand, there is a hyper-capitalist use and usufruct of Blockchain technologies 1.0 and 2.0 while, on the other, a blockchain that is instrumental for post-capitalist movements that are based on peer-to-peer communication, resource commons and collaborative action. This somewhat paradoxical use of blockchain has important implications for education.

3 Blockchain Technology in and for Education

Today, the mainstream perception of educational technology is usually through the prisms of Big Data, participatory social media, STEM education and data mining/analytics with subservient technologies such as Artificial Intelligence and Machine Learning. This context as well as pedagogic trend chiefly pertain to and depend on the 'Google's System of the World,' which is, according to George Gilder, an awkwardly Marxist information structure that is being replaced by a new world order of distributed ledgers (2018). If the author of *Life after television* (Gilder, 1994) is correct, blockchain technology is a strong contender to be the most fundamental paradigm shift in digital communication and educational technology.

Much of the reported use of blockchain technology is, however, still at the level of Blockchain technologies 1.0 and 2.0. The *Project Connect* of the UNICEF is running, for example, a dozen of blockchain-mediated educational projects such as bringing open source technologies to developing communities, investment in educational projects, institutional funding, charity donations and crowdfunding (Cacioli, 2020). Across all of these applications, the main benefit is that records such as accounting, investments and donations to education cannot be altered or controlled by any single authority.

Blockchain technology can execute other tasks in education administration and management through its shared ledgers: School staff hiring via smart contracts, continuing professional development (Clark, 2016), performance and payments, from their first day of work to retirement pensions. Education institutions can apply blockchain technology to administer academic activities, for example, administering MOOCs all the way through actual degrees (Clark, 2016). A degree deserving course work could be executed:

smart contracts managed in blockchain systems could establish conditions under which a student would receive a certificate from a provider, and a series of those contracts could define a full degree program. As these students' progress toward degree fulfillment, their blockchain records could be tracked automatically and shared in real time with potential employers. (McArthur, 2018, p. 3)

Sharpley and Domingue report the University of Nicosia in Cyprus as the first university in the world to issue academic certificates with authenticity verification

through the Bitcoin blockchain (2016). Authenticity verification could be within a single institution such as the reported case of Holburton School in San Francisco that uses an intra-institutional blockchain for authentication of certificates as well as among a consortium of education institutions (Clark, 2016). Furthermore, a national blockchain database of academic credentials could be created at different levels of education (ibid.).

Referring to a sizable international effort to lower barriers in favor of the global mobility of students and academics in the past two decades, Gatteschi et al. (2020) point out that blockchain technology could greatly contribute to a more effective and efficient recognition and management of certification and accreditation. Due to its immutability, transparency, and trustworthiness, blockchain technology can not only radically curtail degree frauds (Chen et al., 2018) but also monitor the mobility of students, educators and professionals. This can be done, say, through ‘some automatic solutions ... which trigger a transaction as soon as a degree is earned, or an exam is passed’ (Gatteschi et al., 2020, p. 106).

The scope of international administration of degrees and credit transfer would be way broader, more accurate and transparent than the extant regional mechanisms such as the Bologna Process, the Brisbane Communiqué and other few initiatives by the Association of Southeast Asian Nations (ASEAN) and ASEAN + 3 (China, Japan and South Korea) (Chao, 2011; Dang, 2015). A crucial characteristic of blockchain technology in degree and accreditation management is its rescinding interventions and arbitration by third party organizations and government bureaus. A famous case was reported in an editorial column of a nursing education journal by Diane Skiba (2017): ‘MIT’s Media Lab has been collaborating with the Learning Machine, which created a wallet app that allows users to have access to their blockchain-based credentials and add them to their digital resumes’ (p. 220).

As for learning and teaching proper, which is the main mission of education, the majority of recent literature continue to speculate on the potentials of blockchain technology rather than its actual application (Chen et al., 2018; Gatteschi et al., 2020; Sharples & Domingue, 2016; Zhong et al., 2018). Nevertheless, as early as February 2016, a Japanese technology company claimed to have successfully adapted blockchain technology to enable ‘open and secure sharing of academic proficiency and progress records’ (Sony Global Education, 2016). Blockchain technology with its distributed ledgers of semi-public data could record learners’ acquired competencies, that is, an individual’s previous learning history stored on a publicly distributed ledger so that even the learner herself/himself is fully informed of her/his attained or lacking competencies (Gatteschi et al., 2020).

Chen et al. (2018) offer other potential future use of blockchain technology in actual teaching and learning. They suggest three areas of learning and instruction with greater potentials for gain: formative assessment, learning activities design/implementation, and records of learning processes. A team of Hong Kong researchers (Zhong et al., 2018) proposed using the *Ethereum 1.0* blockchain platform for e-learning of vocabulary. However, their study is a conceptual modeling, hence, again, a potential application still to be tested. The study does not seem to be

aware of the problem of proof-of-work of *Ethereum 1.0* whereas *Ethereum 2.0* that uses a different technique called proof-of-stake is not mentioned.

An area of education that could potentially benefit the most from blockchain technology is learner evaluation and assessment (Clark, 2016). Here, students are the Nodes of a blockchain; their individual performance as well as peer evaluation of individual contribution to the group work in the context of collaborative learning, could be fairer, more efficient and safely stored (Chen et al., 2018).

Even at the level of modeling and conjecturing about education blockchain can sometimes pose challenges. The proposal by Chen et al. (2018) is that students' learning can be attested in distributed ledgers, 'crypto-learning' so to speak, and disclosure of related information should be only among the partakers of the same blockchain and/or via smart contracts. Their suggestions are generally plausible yet with two glaring issues. First, their reduction of smart contracts into a contractarian tit-for-tat teacher–student relationship is rather questionable. If so, it could disrupt cultural sensitivities and local philosophies of education. Second, their suggestion of converting learning into money—digital coins or paper bank notes does not matter—and storing them in an 'education wallet' is even more problematic. The very act of monetizing learning and teaching not only would be an act of cultural invasion but also a clash against the almost universally accepted value of 'learning to be' (Delors & UNESCO, 1996).

Swan (2015) also describes human learning in contractarian terms: 'Bitcoin MOOCs (massive open online courses) and smart literacy contracts encompass the idea of opening up emerging-market smart-contract learning to all individuals worldwide' (p. 61). Thus, almost every area of teaching and learning is a potential beneficiary of blockchain technology: 'Overall, blockchain can be used to construct a balance to measure learning process and outcomes. It is a reliable and an equal proof of value for everyone' (Chen et al., 2018, p. 7).

A smart contract learning linked to the utilitarian philosophy of 'learn to be paid' or 'learn to earn' has a number of technical and sociological complications. To start with, we need to keep in mind that the first and primus inter pares cryptocurrency *Bitcoin* is, in fact, not a coin or currency but, rather, a digital standard gold with a huge difference that its value can fluctuate far wider than gold. Thus, *Bitcoin* has been so far a hot arena for prey and predators of financial speculations. Thus, instead of naming blockchain-mediated education 'Bitcoin learning' amidst an early enthusiasm (Swan, 2015), it is probably more proper to use the term 'smart contract learning.'

Based on the discussion in this section, signs are abound that blockchain technology has not been fully exploited in education. Most literature are about future possibilities of blockchain technology and claims of transferability of some specific aspects of it from various industries to education. Reported cases of actual application in education are significantly fewer and they are mostly pilot projects/experiments within one single or a few institutions. The main cause for this phenomenon is arguably neither a lack of need nor willingness of the education sector to use this emerging technology. The next section identifies a twofold cause of such a tepid

technology adoption rate: (1) Technical constraints in implementation, and, (2) weak sustainable development goals.

4 Challenges of Blockchaining Education

- (1) There are important technical constraints for the adoption of blockchain technology in education. A first and perhaps the most challenging one is the proof-of-work, that is, the consensus mechanism for the verification of new blocks (see the Introduction section). The greater the size of a blockchain, the bigger and more costly its proof-of-work (mining) gets. The scale and intensity of mining is simply mindboggling, for instance, *Bitcoin* miners compute about 450 thousand trillion solutions per second at a total cost in energy, machinery and maintenance labor of about USD 600 million back in 2015 (Watters, 2016). Mining a blockchain in education will similarly involve ‘the solving of complex mathematical problems as part of the validation process without which fraudulent blocks could be added to the chain. So the transposition of mining into the context of the Blockchain Learning will require special consideration’ (Devine, 2015, p. 4).

The problem does not end with the rewarding of the proof-of-work of miners. An education blockchain with students as Nodes, the rightful owners of their respective blocks, has additional challenges of *qualia*, that is, those aspects of learning that resist quantification:

If a student were to provide one of these [mining] services in return for a fee – how would the Blockchain manage the process... the technological mechanics of inviting participation, distributing assessments, collecting results and allocating rewards. (Devine, 2015, pp. 6–7)

An intra-school blockchain created, used and mined within one single education institution or small consortium is likely to be sustainably operated. A larger education blockchain at the national or global level, however, might be a *pointless* project as it is very likely to fail to exchange information in a decentralized community without having to go through several third parties. For example, university degrees are almost always granted by the state or university, which are third parties in a blockchain with student-Nodes.

Furthermore, Watters pointed out a fundamental ambiguity of an education blockchain where institutions are Nodes—trust:

discussions about ‘trust’ and the blockchain in education often frame students (and/as potential employees) as being untrustworthy – as lying about their degrees or their skills... The blockchain would purportedly verify those credentials. But it’s worth asking too if institutions are trustworthy. Which students, which institutions are and are not trusted? Why? By whom? What is actually the source of ‘trust’ in our current credentialing system?... How would the trustworthiness of blockchain credential-issuing institutions be measured or verified? (Watters, 2016)

An education blockchain would create a permanent record where a specific information cannot be changed or removed, that is, it remains immutable and unalterable to all Nodes involved. It has been questioned, however, whether this is really desirable for students themselves (Chen et al., 2018), or, whether a permanent record goes against the basic principle of education for growth, transformation and if not even redeeming/reinventing oneself with a second or third chance (Watters, 2016).

- (2) A second major cause of scarce real application of blockchain in education is, in my view, its lack of alignment with an authentic philosophy of sustainable development of education. This is a complex and multifaceted issue.

Although Audrey Watters considers herself to be the ‘Cassandra of Ed-Tech,’ who tells the truth but nobody believes in it, I fully agree with her that education blockchain is still more of a hype today than a real solution of the many real life problems education faces. Instead of conjectures on potentials alone, we educationists who are interested in harnessing the power of this new technology should first ask a few teleological questions, ‘What problems can blockchain solve in education? What problems—technologically, ideologically—might the blockchain’s adoption in education create?’ (Watters, 2016).

For one thing, the global cryptocurrency experience tells us that a piece of information in a blockchain might be immutable but not its value. The value of the same information fluctuates at the rate of human need and greed. We have to keep in mind that, in education, the value and usage of new pedagogies and technologies have many times engendered unintended consequences. To illustrate, the direction of the conceptualization of giftedness and high ability was set a century ago by Binet’s intelligence measurement and William Stern’s quotient, yet it unintendedly brought about a new form of social stratification—fitting people into a normal curve, assigning scores to their knowledge, determining social circles and ability-based institutional streaming (Park, 2016). Education blockchain with permanent records of student abilities and attainments could also produce a new form of social stratification that may well be worse and more universal than the case of the intelligence quotient. Ultimately, the type and degree of arbitrariness of institutional trust and value might hinder global efforts to build a sustainable future.

Despite the great potentials and efficiency of blockchain, without a clear philosophy of what the goal of education is and where we want to be, the question of ‘What problems can blockchain solve in education?’ would remain unanswerable. It is plausible that blockchain empowers learners by granting ownership and control over their credentials (Schaffhauser, 2016) but it can also derail the purpose of education by generating a novel form of social inequality and inequity, or worsening the dated ones. Blockchain technology might turn schools, universities and related social institutions into an arena of social control and perpetuation of power, for instance, a permanent record in a fashion similar to the Social Credit System and mass surveillance could lead to serious privacy problems and oppression (Kostka, 2019; Snowden, 2019; Song, 2019).

This chapter submits that, instead of serving hyper-capitalism or authoritarian social control of education and development, blockchain should ideally serve an

education that prioritizes peer-to-peer cooperation and sustainability. The bottom line of education blockchain proposed by this chapter is not the technology for the sake of technological novelty per se but, rather, education's chief goals of social justice and sustainable development. Through peer-to-peer communication, autonomous organization and contribution to the globally distributed 'education commons' with shared innovative knowledge, pedagogic resources and open cooperative education systems (see Bauwens et al., 2019). In other words, blockchain would have given a far better use with a clear philosophy of a sustainable and decentralized development of education where the main goal lies beyond the frontiers of bureaucratic efficacy, academic credentials and the 'learning is earning' sort of monetary enticements cum social control.

In what constitutes the most recent changes in the world of blockchain, Tett (2021) reports that the total value of the cryptocurrencies market of USD 1.5 trillion is now under scrutiny and retaliation as governments and banks try to counter cryptocurrencies' influence. In June 2021, the Bank for International Settlements (BIS)—the mother and arbiter of all banks including central banks—stated: 'Innovations such as cryptocurrencies, stablecoins and the walled garden ecosystems of big techs all tend to work against the public good element that underpins the payment system' (as cited in Tett, 2021) and BIS proposed 'central bank digital currencies' as a solution (Tett, 2021). In fact, the *stablecoins* themselves were launched by commercial institutions in their attempt to counter the instabilities generated by cryptocurrencies, and by pegging *stablecoins* to sovereign currencies and equivalent standards. *Ripple*[®] is, as an alternative, a far more practical and agile application of blockchain technology since it works with a limited number of international banks that form a consortium and, not without paradox, to make transactions without paying bank service charges. What is relevant for education is that education blockchain is not invulnerable or immune to regulations by external forces.

5 Conclusion

Blockchain is considered as the next technology-mediated socioeconomic mega trend after the ongoing era of Net Neutrality and Big Data (Gilder, 2018). It promises to provide humankind with a Cryptocosm *cum* Life 3.0, hence, regarded as an all-encompassing and disruptive technology. This chapter explored blockchain technology and its impacts on education.

The extant literature on harnessing its potentials for education speculate on the prodigious potentials of this technology. They conjecture on how industrial and financial blockchain can be adopted by education, and across almost all of its subdomains such as financial procurement, school funding, donations, school payroll, teacher professional training, human resource management, cross-border academic credit recognition, certification and degree transfers, monitoring students' learning and attesting their actual capabilities.

Blockchain with its distributed ledgers certainly promises greater efficiency and control over educational administration and management. However, its real life application is almost exclusively reduced to identity authentication, degree certification attesting and a few cases of cryptocurrency-mediated monetary transactions in terms of school fees and donations. Two main causes of this lagging adoption rate of blockchain in education have been identified and discussed, namely, the technical and philosophical constraints.

Technically, blockchain is yet to be adopted by the mainstream industries due to its scalability issues and still limited technical familiarity and skills (Gatteschi et al., 2020). The phenomenon of an even smaller number of applications in education is, it was argued, due to the problem of proof-of-work, which is greater, the bigger is the number of blockchain Nodes. It is not possible to find any real life example of massive and global education blockchain at a comparable scale of cryptocurrencies (in millions). There is simply no clear and appealing incentive and motivation for performing its proof-of-work although this situation might change with the upcoming merging of *Ethereum 1.0* and *Ethereum 2.0* with a new technique of verification called 'proof-of-stake' expected to occur in 2022.

Philosophically, existing education blockchain usages tend to be excessively pragmatic in trying to give solutions to a narrow range of administrative and managerial tasks, and within an institution or within small consortium of institutions at most. More glaringly, education blockchain lacks a robust philosophy of education aligned with sustainable development. It was suggested that perhaps a cooperative-common sort of education blockchain where resources are shared for collaborative and sustainable development might be more salutary for our common future, and it should be not only for the global metropolises but for all open societies.

To conclude, blockchain in and for education is a plausible forecast of an upcoming all-encompassing mega-transformation yet, as a technology, it is subject to the principle of magnification and reduction, that is, 'For every enhancement of some feature, perhaps never before seen, there is also a reduction of other features' (Ihde, 1993, p. 111).

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Author Index

A

Alobaid, Azzam, [143](#)

C

Chan, Chi-Keung, [87](#)

Chan, Ka-Wai Kelly, [87](#)

Chan, Sumie, [125](#)

Chan, Wing Lam Wendy, [49](#)

Chen, Shen, [203](#), [253](#)

Chiu, K. F. Thomas, [33](#)

Chui, Chi-Fai Raymond, [239](#)

Chung, Hau Ching, [239](#)

Chun, Man Keung, [223](#)

G

Gayatri, Putri, [253](#)

Goos, Merrilyn, [299](#)

H

Hu, Hsin Li, [279](#)

L

Lan, Min, [107](#), [343](#)

Law, Cheuk-Yin Samuel, [239](#)

Li, Liuyufeng, [183](#)

Li, Shao-Fu, [365](#)

Li, W. Ken, [299](#)

Lo, Chung Kwan, [223](#)

Lo, Noble, [125](#)

M

Ma, W. K. Will, [317](#)

N

Ng, Kwan-Keung, [365](#)

Ng, W. Y. Annie, [19](#)

O

O'Rourke, Breffni, [183](#)

P

Park, Jae, [383](#)

S

Sit, Hingwa Helena, [203](#), [253](#)

Siu, Yat-Fan Nicholson, [239](#)

Song, Zhao Xun, [279](#)

T

Tso, Anna Wing Bo, [3](#)

VVan Nguyen, Tuyen, [203](#)**W**Wong, Pui Yun Paulina, [67](#)Wong, Wai Chung Gary, [67](#)Wu, Jing, [279](#)Wu, Pei-Ying, [365](#)**Z**Zhai, Shuqin, [343](#)