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K-12 teachers' perceptions of the effectiveness of online EFL teaching and learning during the COVID-19 pandemic

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Abstract: During the Coronavirus disease outbreak, education in schools and universities was conducted through online platforms worldwide. School teachers in China have had a taste of online teaching, which never appeared to be a necessity before the COVID-19 pandemic in 2020. This research explores the effectiveness of English as a foreign language (EFL) teaching at the primary and secondary school levels during the COVID-19 pandemic in China. The research tools comprise questionnaires and semi-structured interviews. A total of 132 teachers from more than 10 provinces completed the online questionnaire, and 12 teachers were involved in semi-structured interviews. The results showed that while some EFL teachers adopted effective online pedagogies, others encountered challenges in online teaching. The teachers who had comprehensive Technological Pedagogical Content Knowledge (TPACK) or with previous online teaching experience tended to be more optimistic about teaching effectiveness in online language education. However, less training and a lack of TPACK and skills can hinder effective online teaching.

Keywords: COVID-19; effectiveness; K-12 English; online teaching

1 Introduction

During the COVID-19 pandemic, the major form of education was redefined unprecedentedly. Online education weighs heavier now than ever before and provides schools with a teaching medium that can maintain the standard of

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education (Van Rensburg, 2018). Though teachers and students were at a distance in quarantine, technology had, in effect, brought them closer. Various online platforms have provided teachers and students with a new online education experience. Teaching and learning through online platforms, such as Zoom and Dingding, have become a worldwide trend (Zou, Huang, Ma, & Qiu, 2021). As a consequence of the Coronavirus disease outbreak, online education has generated considerable interest among educators worldwide and is likely to become an indispensable part of school teaching in the foreseeable future. Despite the increased popularity of e-learning wide application in modern education, especially in higher education (Wu et al., 2020), only a few studies have been conducted at primary and secondary school levels. Moreover, few studies have been conducted regarding teaching effectiveness at the aforementioned levels in English as a foreign language (EFL) teaching. This study, thus, aims to investigate the effectiveness of online English teaching in China at primary and secondary school levels during the COVID-19 pandemic and to call for questions and more discussions with respect to teaching effectiveness in online EFL teaching and learning. The researchers are particularly interested in exploring the potential factors affecting online teaching effectiveness and how teachers might differ regarding their efforts to maximise this effectiveness. Although online teaching effectiveness is yet to be clearly defined, this exploratory research aims to provide educators with more insights into the current situation regarding online EFL teaching and learning in the hope that EFL teachers and policy makers will have a better understanding of the challenges and potentials of online education at school levels. If online education takes place again in the near future, educators can be better prepared, and in turn, students can enjoy an online learning experience of higher quality.

During the period when English teaching and learning were conducted online, teachers faced challenges due to their lack of technological knowledge. Thus, this paper proposes an enhanced emphasis on Technological Pedagogical and Content Knowledge (TPACK) (Mishra & Koehler, 2006) in teacher education and professional development. This paper further suggests ways regarding how teaching effectiveness can be improved and how teaching efficiency can be achieved in online education. Therefore, the research questions in this study are as follows:

1) How were online English classes conducted during the Coronavirus outbreak?
2) How do teachers perceive the effectiveness of online teaching during the Coronavirus outbreak?

2 Literature review

2.1 CALL and K-12 online education

Since the late 2000s, there has been a significant increase in research regarding technology use in language education (Chang & Hung, 2019), which can play a fairly important role in teaching, and CALL has become normalised (Bax, 2011). A study targeted at a science class revealed technology's potential for bridging the gap between teacher–student interactions and helping students build connections between academic contents and their understanding of these contents (Kim, 2020). Drawing a conclusion from 50 years of human–computer studies, Gaines (2019) stated that the focus of CALL research has shifted from facilitating human–computer interactions to managing the highly connected virtual and real worlds. In the field of CALL, only two years ago, in 2019, scholars' remained concerned about the constantly evolving technologies that can challenge educators who are not ready for them (Lomicka & Lord, 2019). Furthermore, CALL was only considered helpful in enhancing language education, instead of the predominant media for language education, and education at large (Loucky, 2019).

Compared to traditional classroom teaching, the use of the computer only plays an assistant role, whereas the dominant feature of distance education lies in the fact that learners are at a distance from their teachers, teachers and learners can only communicate on their computers, tablets or other devices that bring the teachers and the learners together via the Internet. It is technology that makes online learning possible; it plays an essential role in distance education (Ally, 2008). Chang and Hung (2019) indicated that the involvement of technology substantially influences the learning of a second or a foreign language.

Meanwhile, interaction also plays a vital role in the CALL context, as it allows learning to occur (Gass, 1997). While receiving distance education, the learners use technology to interact with their teachers; meanwhile, technological support is provided to learners. Learners are expected to interact with the content, the instructors and other learners (Ally, 2008). Teachers and students can interact through texts and voice during online teaching and learning. Texts are considered supplementary to voice, and in an online environment, text turns often occur concurrently with voice turns (Nguyen, Vicentini, & Langevin, 2018). However, some students doubt the usefulness of online interactions and complain about the inconvenience of exchanging texts in online synchronous

classes (Miwa & Wang, 2013). In terms of learners' interactions with the content, learners favour instructional videos that are clear and logical, as well as rich in content, and can therefore learn from the videos while enjoying the learning process (Ding, 2020).

In terms of interaction types in online education, most research has been conducted on the following three types of interactions: interactions among the students, between students and teachers and between students and the content. Bernard et al. (2009) emphasised all three interactions and stated that compared to interactions in mediated synchronous online classes and face-to-face settings, there is a strong association between the strength of interactions and achievement in asynchronous online courses. Sharifi, Rostami AbuSaeedi, Jafarigohar, and Zandi (2018) discovered that, compared to interactions among students or those between students and the content, teacher–student interactions are the least effective. Bernard et al. (2009) suggested that student-centred interactions can improve the effectiveness of teacher–student interactions. In contrast, Means, Toyama, Murphy, and Baki (2013) claimed that synchronous student–student interactions do not contribute much to the overall effectiveness of online learning.

Although the literature has highlighted the importance of interactions in online learning, it remains unclear how teaching effectiveness is associated with the various interactions occurring in distance education, especially in distance language education. In addition, computers never played a dominant role in teaching and learning before the COVID-19 pandemic. Thus, many previous studies in the CALL field might not cover the teaching and learning context in massive online EFL teaching and learning, as in the COVID-19 context. In 2020, and even in the early 2021, the COVID-19 pandemic forced a shift towards distance education where, compared to classroom teaching or blended learning, teaching and learning occurred solely online through the Internet and computers or mobile devices.

2.2 Teaching effectiveness in an online context

Previous studies have reported different results regarding the effectiveness of online teaching. Means et al. (2013) conducted a meta-analysis on 50 effects collected from 45 studies and found that the learning outcomes tend to be more desirable when online learning is involved in some form, either solely online or blended learning. In online synchronous classes, students focus more on the process, instead of the product, of completing an academic task through synchronous computer-mediated communication. Often, students produce

fewer words at the end of a task, but the fact is that they have spent longer time discussing (Nguyen & White, 2013). In addition, while students make mistakes in both synchronous and asynchronous learning activities, errors, which are considered opportunities for acquiring new knowledge, are more likely to be prompted in synchronous learning settings (Pineda, 2019). Asynchronous activities, in contrast, provide learners with opportunities to identify the types of errors they make, and thus, help them develop and enhance language awareness. Furthermore, according to some scholars, tools can make learning and teaching easier and more effective. While Rice (2006) argued that the medium of distance education does not appear to play as essential role as the teachers and students do with respect to the effectiveness of distance education, Loucky (2019) suggested that computer-mediated communication (CMC) and CALL tools can differentiate or individualise instruction, engage students at a higher level and make the learning content more accessible along the teaching and learning process.

Although most previous studies yielded positive results in teaching effectiveness in the online teaching context, it remains unclear whether teaching effectiveness is still positive when all teaching and learning has been moved online during the COVID-19 period. Thus, more research should be conducted to investigate teaching effectiveness in EFL teaching during the COVID-19 pandemic.

2.3 Theoretical framework for online teaching

To theoretically explore the teaching effectiveness in massive online EFL teaching during the pandemic, the researchers are interested in the following factors that might have significant effects on the effectiveness of online English language classes: TPACK and Hubbard's (2019) eight principles in the CALL context. The researchers applied the aforementioned three theories to investigate English language teachers' perceived effectiveness of online English language classes.

2.3.1 TPACK

Mishra and Koehler (2006) built upon the pedagogical content knowledge proposed by Shulman (1987) and proposed the TPACK framework, which involves technological knowledge, pedagogical knowledge and content knowledge. It is an advanced framework that helps teachers to consider how to effectively teach and engage students in technology, based on the pedagogical and content

knowledge that they are already equipped with. The TPACK framework has been widely used as the framework for research conducted on CALL (Boboc, 2015; Brinkley-Etzkorn, 2018).

2.3.2 Technology acceptance model

Davis (1989)'s technology acceptance model (TAM) was developed from the theory of reasoned action (TRA) introduced by Ajzen and Fishbein in 1980. TAM takes TRA, introduced by Ajzen and Fishbein (1980), as a general model and derives from perceived usefulness and perceived ease of use. Perceived usefulness indicates the extent to which people believe a technology can assist them in performing a better job, whereas perceived ease of use refers to the amount of effort users consider that will require when using the technology (Davis, 1989). According to Davis (1989), when language learners believe that a computer is easy and almost effortless to use, and is helpful to their language learning, they might develop a favourable attitude towards the use of computer-assessed language learning (Figure 1).

2.3.3 Hubbard's eight principles

Hubbard (2019) suggested that the use of technology brings advantages to the learning and teaching process in the following eight aspects: *learning efficiency*, *learning effectiveness*, *access*, *convenience*, *motivation*, *teaching efficiency*, *teaching effectiveness* and *institutional efficiency*.

Based on the three aforementioned theories, the researchers would like to explore and thus understand the variables that can significantly affect online teaching effectiveness and how teachers vary with regard to effective online language teaching.

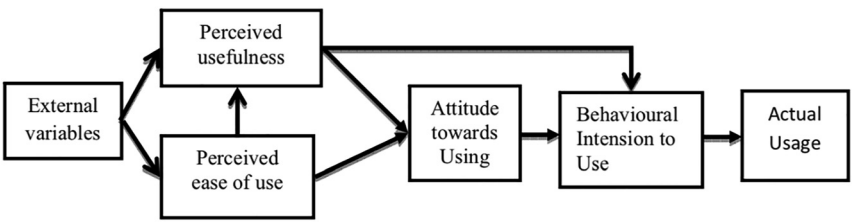

Figure 1: TAM (Davis, 1989).

3 Methodology

3.1 Participants

The online questionnaire was completed by 132 K-12 EFL teacher participants at primary or middle schools from 12 provinces or cities in China, including northern region, such as Beijing (N = 33) and Hebei (N = 10), and eastern region, such as Jiangsu (N = 40) and Shandong (N = 22). Among the 132 participants, 42 were male and 90 were female. Their ages ranged 20–60 years old. Of the participants, 41% (N = 55) had more than 10 years of teaching experience in conventional classroom teaching.

In terms of levels, 29 respondents (21.6%) were teaching Year 1–Year 3 students, 53 respondents (39.6%) were teaching Year 4–Year 6 students, 28 respondents (20.9%) were teaching Year 7–Year 9 students and 24 respondents (17.9%) were teaching Year 10–Year 12 students. The class size ranged from less than 20 to more than 60 students. Approximately 80% (N = 107) of the participants perceived that they had used online sources to enhance classroom teaching, and 52% (N = 70) of the participants had had experience in using some online teaching platforms before the teaching and learning process was affected by the COVID-19 pandemic.

3.2 Instruments

The researchers employed mixed methods to collect data, including questionnaires and semi-structured interviews. The questionnaire contained 40 questions. First, the participants' demographic information, including gender, age, years of teaching and taught students' grades and class size, was collected. In addition, the questionnaire was particularly designed according to the concepts of TPACK (Mishra & Koehler, 2006) and Hubbard's (2019) eight principles. The participants were required to evaluate their own technological, pedagogical and content knowledge; their acceptance of online teaching and their perceived effectiveness of online teaching. The questions regarding the concepts of TPACK and Hubbard's eight principles had to be answered on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

To better understand teachers' perceptions of the effectiveness of online teaching, semi-structured interviews were also adopted. In the interview, the researchers were particularly interested in 1) teachers' communication and interaction with their students in online classroom settings and 2) teachers' experience

of transitioning from conventional face-to-face teaching to online teaching. Twelve teachers were invited to participate in the interview, each of which lasted approximately 30 min. The interviews were audiotaped and transcribed. Then, the interview data were analysed with the same categories as those obtained from the questionnaire data. The interviewees were coded as T1, T2, T3, etc.

3.3 Data analysis

The researchers aimed to explore and thus understand the variables that can significantly affect the effectiveness of online teaching and how teachers vary in regard to effective online language teaching. Both quantitative and qualitative research methods were used in this study. SPSS 22 was used in the quantitative analysis process. Meanwhile, the interview data were discussed in the same categories as questionnaire data.

The researchers developed three scales pertaining to the concepts of TPACK, Hubbard's eight principles and TAM. There were 22 test items, complex latent factors and multidimensional relationships in the present study (Table 1).

3.3.1 TPACK

The researchers included eight TPACK questionnaire items (Mishra & Koehler, 2006). The following is a sample survey question: *I can properly integrate 1) teaching content, 2) teaching method and 3) technology (using the Internet, digital media, etc.) into online teaching*.

3.3.2 Hubbard's eight principles

Based on the detailed descriptions provided by Hubbard (2019), the researchers created nine questionnaire items related to each of the following nine concepts: learning efficiency, learning effectiveness, access 1-interactions, access 2-materials, convenience, motivation, institutional efficiency and teaching efficiency. The following is a sample questionnaire question for "learning efficiency": *My students get/download course materials more conveniently and quickly*.

3.3.3 TAM

Five questionnaire items were designed according to Davis et al. (1989) for the researchers to better understand the participants' attitudes towards online

Table 1: Items and corresponding factors.

Factors	Items	Scales
TPACK 1	I can properly integrate 1) teaching content, 2) teaching method and 3) technology (using the Internet, digital media, etc.) into the online teaching.	TPACK (8 Items)
TPACK 2	I can help other teachers coordinate 1) teaching content, 2) teaching method and 3) technology (using the Internet, digital media, etc.).	
TPACK 3	I can use the evaluation tools provided by the network technology platform to evaluate online teaching and learning.	
TPACK 4	I can use the online teaching platform to strengthen students' language skills.	
TPACK 5	I can effectively combine the online teaching platform with the teaching content to help students master knowledge.	
TPACK 6	My online and offline teaching style has not changed much.	
TPACK 7	In the courses I teach, there are a wealth of electronic resources that need to be presented to students.	
TPACK 8	I think that in terms of teaching methods, online and offline are basically the same.	
1 My students are not easy to forget the knowledge points presented on the online teaching platform, and they have more knowledge than what I actually teach.		Hubbard's Hypotheses (8 Items)
2 My students experience richer interaction methods (such as human–computer interaction, students use computers to do questions, get feedback, etc.).		
3 My students get/download course materials more conveniently and quickly.		
4 My students can study at the time and place they choose.		
5 My students are more actively involved in teaching activities.		
6 My students don't need to pay expensive tuition, textbooks, materials, etc.		
7 My actual teaching activities (preparing lessons, teaching, after-school tutoring) have been reduced.		
8 The teaching effectiveness of the course I teach has improved.		
TAM1	It is easy for me to deliver synchronous online classes.	TAM (5 Items)
TAM2	It is easy for me to prepare students with online classes, as well as follow up after class (Online pre- and after-school tutoring is easier for me).	
TAM3	I think the English course I teach is suitable for online teaching.	
TAM4	I think that online teaching (teaching/pre- and after-school tutoring) can make teaching activities easier and more convenient.	
TAM5	When teaching offline resumes, will you still use the network to assist teaching in classroom teaching?	

teaching. The following is a sample item: *It is easy for me to deliver synchronous online classes*.

Furthermore, internal reliability tests were conducted for each factor based on the items involved. As shown in Table 2, Cronbach's α coefficient for the eight items in TPACK was 0.965; that for the nine items in Hubbard's eight principles was 0.941 and that for the five items in TAM was 0.832. The reliability of each factor was above 0.8, indicating a high reliability of the present factor analysis.

4 Findings

4.1 Research question 1: How were online English classes conducted during the coronavirus outbreak?

All teachers were informed to conduct online teaching at the beginning of the spring semester in 2020, because all teaching and learning had to be conducted online. As such, the teachers received limited training. The questionnaire data showed that 33% of the participating teachers did not receive training before the start of online teaching in March 2020, 53% received training for one week, 12% received training for two weeks and only 2% received training for more than two weeks. This indicates that the teachers could not deliver effective online teaching, as they received limited training in using technology and integration of pedagogy in the online environment.

In the questionnaire, while 44 (30%) participants reported that they neither delivered synchronous online classes nor taught in an asynchronous manner, the remaining 59 (44.1%) participants experienced synchronous classes, 7 (5.2%) experienced asynchronous classes and 24 (17.9%) experienced both classes. This means that most participants adopted synchronous online classes (i.e. live lessons online). Meanwhile, asynchronous classes were also conducted. According to the

Table 2: Internal reliability tests.

Latent factor	Number of items	Cronbach α coefficient
TPACK	8	0.965
Hubbard's eight principles	9	0.941
TAM	5	0.832
All 22 items		0.974

interview data, some asynchronous classes were delivered by selected teachers from the local education council. As T4 explained,

> It was the subject leaders in Suzhou that were involved in arranging the so-called Weike (micro lessons).

Moreover, the teachers tended to hold different opinions regarding whether it is better to have synchronous or asynchronous online classes. For example, T1 expressed one benefit of live classes (i.e. instant feedback from the teacher to the students):

> The advantage of live classes is that teachers can answer students' questions at any time. If students have questions, they can post them to the message box, and the teacher can give feedback almost right away, just like in normal classroom.

However, one teacher thought that students may benefit more from asynchronous classes and develop learner autonomy. As T11 stated,

> I prefer asynchronous classes, because students can watch the recorded videos over and over again, or skip the parts they didn't need. I think it's more autonomous.

While asynchronous classes might have benefited some students, the teachers also expressed their concerns about these classes. As T7 argued,

> Some students are not able to learn from the recorded videos at home by themselves, consequently they hardly ever learn anything from the videos created by the teachers.

In addition, synchronous online classes often lasted longer than recorded lessons. According to the questionnaire data, 98 (72.79%) teachers had live classes that lasted more than 30 min but less than 60 min, 17 (12.59%) teachers had classes that were shorter than 30 min and only 14 (10.37%) teachers reported that they had classes for longer than 60 min. Regarding the length of the recorded videos, T9 stated,

> A recorded video usually lasts for five to six minutes long, and there usually are three to four videos recorded for one particular unit.

In terms of the online platforms utilised during online teaching, various platforms were mentioned in the questionnaires and interviews. *DingDing*, *Tencent Conference* and *Tencent Classroom* were the three most popular platforms used by the teachers for synchronous online classes. For recorded lectures, teachers shared in the interviews that they would record videos and upload them to Cloud Storage Systems, which varied depending on the requirements of the schools the teachers

worked at. Moreover, according to the questionnaire survey data, the teachers used *WeChat* or *QQ* to follow up students' online learning progress, including asking and answering questions and checking homework. Additionally, some teachers used national online platforms and local governments' own online platforms to obtain relevant resources to support their teaching.

Online platforms assisted teaching in multiple ways. Apart from delivering synchronous classes and uploading pre-recorded videos, 88 (65.19%) participants reported that they used the platform for uploading teaching materials, 68 (50.37%) used it for classroom management and 71 (52.59%) used it for after class tutorials (i.e., uploading homework and giving feedback to the students). Furthermore, the teachers used additional functions. In addition, they used a voting system for an online survey or quiz so that they could receive students' responses instantly, and then provide feedback accordingly. Group teaching, audio communications, sharing PPT slides, online tests, online Q&A, checking students' learning processes, taking online attendances and playbacking recorded lessons were also used during online teaching. Teaching assistants were also involved in providing tutorials to the students.

Regarding the interaction during online teaching, 43 (31.85%) of the participants reported that they and their students could both see each other in synchronous online classes through cameras, while 27 (20%) teachers could not see their students, and vice versa. In addition, 41 (30.37%) participants reported that while they could see their students, their students could only see the shared screen. The remaining participants could not see their students, while their students could see them. While some teachers could see their students, they chose not to do so for the reasons explained below:

> I can see my students, but I usually don't choose to see them, because the Internet will be jammed if all the students turn on their cameras. (T3)

Meanwhile, the teachers' attitudes varied when they interacted with their students in synchronous classes; 84 (62.22%) of the participants perceived that they interacted with their students using the microphone function provided by the online teaching platform, 25 (18.52%) attempted to have students work in pairs and groups using the microphone served by the online teaching platform, 51 (37.78%) explored the chat box function of the teaching platform and interacted with their students through messages posted onto the chat box and 49 (36.56%) participants asked their students to interact with each other using the chat box. However, a few teachers suggested that they wanted to be careful while choosing to take advantage of the chat box. As T7 suggested,

> Typing is a slow way to communicate, and it can be very time-consuming considering the limited amount of time we have for each lesson.

In addition, some teachers increased the number of questions they would normally ask in class, while others gave their students permission to try and use some interactive functions provided by the teaching platform (e.g. sharing screen and highlighting). Most teachers commented that online teacher–student interactions were achieved through speeches. T10 added,

> The teacher-student interaction was done mostly through speech. We also typed when some students' network couldn't work properly. However, for the teachers, we want students' instant voice response, because when students answer their face will be displayed on the screen, which is much better than typing on the screen.

Furthermore, the participants provided positive comments on interactions. The findings from the questionnaire showed that 98 (72.59%) of the participants considered it essential for teachers to interact with their students in online synchronous classes, and 80 (59.26%) argued the significance of student interactions. This indicates that most participants considered interactive activities to be fundamental in online classes. Nevertheless, two (1.48%) participants still considered it possible for teachers to have no interaction with their students in synchronous online classes. In addition, several teachers doubted the practicality of interactive activities in online classes. As T3 commented,

> I don't think student interaction is very feasible, because if you have two children discussing, they can't see each other, but we can hear the sound of their discussion, we can hear the process.

Furthermore, several teachers doubted the practicality of interactive activities in online classes. They expressed their concerns as follows:

> I think student interaction is important, but the problem is that teachers will not be able to be a good supervisor in the process. It's hard to supervise, and a lot of teachers have shared that they don't know how to organize interactive activities online. (T3)

> We have group discussions, but (the interaction) is rare. For example, if I want two students to have a discussion, they may not get prepared at the same time, which can be a waste of time. Sometimes, I'm mostly worried that the parents will think the class is noisy and in disorder. (T6)

To investigate whether there was a statistically significant association between students' grades and their interactions with the teachers, a correlation

was computed. Spearman's Rho in Table 3 was calculated: r (132) = −0.231, p = 0.037 < 0.05. This means that younger students tended to interact with teachers more often and better in synchronous online classes.

The findings above demonstrate that most participants integrated the synchronous method for online classes, and some teachers used asynchronous classes with video recording, which can benefit students' learning because they can review recorded lessons frequently. This result agrees with that obtained by Ding (2020) in their study regarding the benefit of video-recorded lessons on learners' online learning. Furthermore, either teacher–student or student–student interactions by speaking or typing messages were adopted during online teaching and were perceived as important by the participating teachers. These two types of interactions meet Ally's (2008) expectation in an online learning environment. This finding corresponds with Nguyen et al.'s (2018) claim that text interaction can reinforce voice interaction in the online teaching context. This is because interactions are fundamental and can improve the effectiveness of online teaching, which can enhance learners' understanding of the academic content (Kim, 2020). In addition, students can respond well if the interaction is carried out. This suggests that interactions should be considered during live online teaching, although there are some difficulties sometimes. This result is consistent with Bernard et al.'s (2009) suggestion on interactions during online teaching, especially for student–student interaction, as highlighted by Sharifi et al. (2018). Moreover, the result corresponds with Loucky's (2019) suggestion on high engagement for learning through online communication. The findings above show that student–student interactions can also support learners' learning progress, which contradicts Means et al.'s (2013) study on the uselessness of student–student interactions, because the current online technological tool for communication is much better than that available 10 years ago and it is now convenient to conduct interaction online. Meanwhile, teachers should be trained on how to control online interactions in order to provide more effective online teaching and learning.

Table 3: Association between students' grades and their interactions with the teachers.

	Students' Grade
Effect size	−0.231
p	0.037
Valid sample size	132

4.2 Research question 2: How do teachers perceive the effectiveness of online teaching during the coronavirus outbreak?

To understand how teachers perceive the benefits of online teaching, the researchers adapted Hubbard's eight principles and invited the participants to rate each principle on a scale of 1–5 according to their own experience (Table 4). Regarding teachers' perspectives on teaching efficiency pertaining to online teaching, 46 (34.07%) out of the 132 participants indicated "strongly disagree", 31 (22.96%) indicated "disagree", 33 (24.44%) indicated "neutral", 17 (12.59%) indicated "agree" and 7 (5.19%) indicated "strongly agree". The mode for this variable was 1, and its mean, based on the 132 valid responses, was 2.29 (SD = 1.201), only slightly exceeding the two on the five-point Likert scale. The percentages, mean score and mode score suggested that more than half of the participants indicated disagreement with the statement; that is, most participants did not consider online teaching to be as efficient. The means of other factors were less than 3, which means that teachers thought online learning may not be effective and efficient. Only the means of access to materials and convenience were more than 3, indicating positive comments from participants.

The teachers in the interviews also expressed similar concerns. For example, as T2 noted,

> Teacher cannot monitor well in online classes, thus it is difficult to keep track of students' learning.

> For the self-disciplined students in class, online course can be effective. However, the rest students lag behind during online teaching.

The results indicate that teachers did not consider their online teaching during COVID-19 to be effective. This may be largely because they received insufficient training and support before conducting online teaching. Therefore, the teachers should be trained to carry out online teaching. As suggested by Hubbard (2019), teachers should be trained and be lifelong learners to learn how to integrate their effective classroom teaching into the online teaching environment. Schools should also provide sufficient training to teachers to help them achieve efficient teaching online.

However, one teacher argued that teaching effectiveness is not impossible to achieve during online teaching, for the teachers would spend more time and effort preparing for the classes compared to traditional classroom teaching.

> We are more serious and careful in preparing online teaching, because I need to concern all the aspects. I invested much more time and energy in online teaching.

Table 4: Hubbard's eight principles data.

	Learning efficiency	Learning effectiveness	Access 1 – interactions	Access 2 – materials	Convenience	Motivation	Institutional efficiency	Teaching efficiency	Teaching effectiveness
Mean	2.56	2.72	2.77	3.05	3.12	2.61	2.80	2.29	2.66
Mode	3	2	3	4	3	3	3	1	2
SD	1.114	0.885	1.235	1.295	0.981	1.158	1.350	1.201	0.972
N	132	132	132	132	132	132	132	132	132

This suggests that if teachers can spend more time and effort, online teaching can be made effective. Thus, more time should be given to teachers to make online teaching effective.

Furthermore, this study analysed the correlations among TPACK, Hubbard's eight principles, TAM and teachers' perceived teaching effectiveness in the online teaching environment during COVID-19.

4.2.1 TPACK

To investigate whether there was a significant association between teachers' perceived teaching effectiveness and the eight TPACK items, the Spearman correlation was computed. As shown in Table 5, Spearman's Rho statistics (correlation value) were calculated: r (132) = 0.56, 0.6, 0.572, 0.627, 0.607, 0.527, 0.503 and 0.594, respectively, and $p < 0.01$ (for each item). These results suggest that teachers' perceptions of the effectiveness of online teaching were significantly related to all eight items regarding TPACK. The direction of the correlation was positive, which means that the higher the teachers rated their own technological, pedagogical and content knowledge, the more effective they considered their online classes to be. This means that when teachers have more confidence in integrating online tools, content and pedagogy in online teaching, they will perceive online teaching to be more effective. If they cannot integrate technology knowledge, content and teaching pedagogy efficiently into their online teaching, the effectiveness of teaching can be impaired.

Similar results could be found in the interview. Two interviewees addressed this factor.

> It is important for teachers to integrate technology knowledge into their teaching. (T2)

> Technology is more like an aid. The teaching effectiveness is mainly influenced by the teacher's own instructional design, while the technology plays a supplemental role. (T9)

Table 5: Associations between TPACK and teachers' perceptions of the effectiveness of online teaching.

	TPACK 1	TPACK 2	TPACK 3	TPACK 4	TPACK 5	TPACK 6	TPACK 7	TPACK 8
Effect size	0.560	0.600	0.572	0.627	0.607	0.527	0.503	0.594
p	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Valid sample size	132	132	132	132	132	132	132	132

Clearly, the effect size regarding TPACK 2 (*I can help other teachers coordinate 1) teaching content, 2) teaching method and 3) technology (using the Internet, digital media, etc.)*), TPACK 4 (*I can use the online teaching platform to strengthen students' language skills*) or TPACK 5 (*I can effectively combine the online teaching platform with the teaching content to help students master knowledge*) was large (larger than 0.5). This indicates that teachers who can help other teachers pertain to TPACK, use the online teaching platform to strengthen students' language skills or effectively combine the online teaching platform with the teaching content to help students master knowledge tend to consider their online classes to be more effective. This means that when teachers with confidence in using the online tools effectively help other teachers use the online technology, they also have positive attitudes towards their own online teaching. These results can help teachers and policy makers to understand how to effectively teach and engage students in an online teaching context.

4.2.2 Hubbard's eight principles

The results in Table 6 illustrate that teachers' perceived online teaching effectiveness was significantly related to Hubbard's (2019) eight principles. The effect size pertaining to learning effectiveness was 0.779. This indicates that teachers' positive attitudes towards online learning were significantly associated with their attitudes towards the effectiveness of online teaching. Teachers who considered their students to easily remember the content taught during online teaching regarded online teaching as effective. Motivation, r (132) = 0.745, played the second predominant role in teachers' perceived online teaching effectiveness. Teachers who participated in the interviews confirmed the motivation that online learning can bring to the students:

> In the beginning of the online course, the students were motivated to learn because they think it's a fun way to study.
>
> The good thing about online teaching is that it can motivate students. Learning a language requires engaging multiple senses. Students can answer questions through voice and communicate through typing, which will motivate them to learn.
>
> With care and encouragement, students are motivated to learn and to do research online regarding certain topics related to class.

This means that the more activities teachers incorporated in online teaching, the more motivated the students were. The teachers were, thus, more positive about online teaching effectiveness. Among the remaining six principles, students'

Table 6: Associations between Hubbard's eight principles and teachers' perceptions of the effectiveness of online teaching.

	Learning efficiency	Learning effectiveness	Access 1 – interactions	Access 2 – materials	Convenience	Motivation	Institutional efficiency	Teaching efficiency
Effect size	0.686	0.779	0.601	0.475	0.506	0.745	0.542	0.667
p	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Valid sample size	132	132	132	132	132	132	132	132

access to materials, r (132) = 0.475, had the least significant association with online teaching effectiveness.

4.2.3 TAM

The results of the third test of Spearman correction above showed (Table 7) that four TAM factors were correlated with teachers' perception of the effectiveness of online teaching ($p < 0.01$). This indicates that teachers' views on whether a class is suitable for online teaching can be associated with their perceived effectiveness of online teaching (TAM 3). The more applicable the teachers think online English classes are, the better the perceived teaching effectiveness can be. In addition, teachers' attitudes towards online teaching (TAM 4) and their perceived ease of online teaching (TAM 1 and TAM 2) can be associated with teachers' perceived effectiveness of online teaching. In general, when teachers think that it is easy to control online classes, they will perceive the effectiveness of online teaching and can accept using online tools in their EFL teaching. This result agrees with Davis's (1989) result that when teachers consider it easy to use the computer technology, they can have a positive attitude towards the use of CALL (online tools in this study) in their teaching.

4.2.4 Region differences

As most participants (78.5%) were from northern (N = 43) and eastern (N = 63) regions, the researchers explored whether there are differences between the two regions from the questionnaire data. Regarding online teaching experience before COVID-19, 74.4% of the teachers in northern region perceived that they had online teaching experience before the pandemic, while only slightly over a third of the teachers in eastern region were engaged in online teaching. Meanwhile, teachers in eastern region valued the teacher–student interaction more than the student–student interaction, whereas those in northern region prioritised the student–student interaction type in online classes.

Table 7: Associations between TAM and teachers' perceptions of the effectiveness of online teaching.

	TAM 1	TAM 2	TAM 3	TAM 4	TAM 5
Effect size	0.410	0.504	0.720	0.699	0.197
p	0.000	0.000	0.000	0.000	0.023
Valid sample size	132	132	132	132	132

Moreover, more than two-thirds of the teachers in northern region (including Beijing) considered online teaching to be as effective as a traditional classroom. However, only one-third of the teachers in eastern region endorsed the effectiveness of online teaching. In addition, the teachers in northern region appreciated the use of the Internet in traditional classrooms much more than those in the east. While most teachers in eastern region (66.67%, $N = 42$) reported that they would only use a little help from the Internet when the pandemic ends and the teaching and learning would return to the traditional classroom, most teachers in northern region (67.44%, $N = 29$) expressed their favour of the use of the Internet and claimed that they would also make the most of this technology in a traditional classroom after the pandemic. These findings indicate that because teachers in northern region have more experience in using online sources and the Internet than those in the east, they are more familiar with the use of online sources and can be considered more effective in online teaching than teachers in eastern region. Thus, 74.42% ($N = 32$) of the teachers in northern region considered it unnecessary to develop online learning courses. However, due to less experience in using online sources and the Internet in classroom teaching, more than 90% of the teachers ($N = 57$) from the east found it necessary to develop online learning courses after the pandemic. Therefore, when teachers gain experience using online sources and the Internet in teaching, they will have more confidence in integrating the Internet and online sources into classroom teaching.

5 Conclusion

The findings in this study demonstrate that online classes were delivered in both synchronous and asynchronous ways in schools in China during COVID-19. Interaction plays a key role in online learning and teaching and should definitely be considered, especially during live online teaching. Training on interaction is necessary for teachers to deliver more effective online classes. Moreover, a positive finding shows that it is not impossible to achieve effective teaching in online education if teachers are equipped with all technological, pedagogical and content knowledge. TPACK and TAM are significantly associated with teachers' perceived effectiveness of online teaching.

Moreover, to achieve effective online teaching, training is significantly important to teachers. Schools and local governments should provide sufficient training and support to teachers. Meanwhile, teachers, as lifelong learners, should also contribute more time to learning how to use and adapt technology in their teaching.

However, this study has certain limitations. Only 12 teachers were interviewed. If more teachers could be involved in the interviews, more data could be generalised. In addition, many other factors might have affected online teaching, which may not be covered in this study. The differences between teachers in northern region and eastern region are limited due to limited data. More data need to be collected to identify the differences in various regions in China. Despite this, the study results provide insights into understanding how teachers can teach EFL at schools in China and which areas can be considered for online teaching in the future.

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