The effect of students’ readiness and achievement in online learning integrates problem-based learning pedagogy during the COVID-19 pandemic

Shigang Ge, Chin Hai Leng, and Mohd Shahril Nizam Shaharom

Abstract
This study aims to use the Problem-based Learning (PBL) method associated with social constructivism to enhance student readiness and achievement for high school English in online learning in China. Considering those in the context of the pandemic, teaching is shifting to online but lacking in more effective interaction. This pedagogy is applied in quasi-experiment research in Guiyang city, Guizhou province. Paired sample t-test is conducted in the experiment on students’ readiness and results show a positive increase ($M = 6.24$) after the intervention $t (49) = 6.77, p = .001$ ($p < .05$), and a significantly raising in dimensions of social competencies with classmates are $M = 3.56$, $t (49) = 6.89, p = .001$, communication competencies are $M = 2.38$, $t (49) = 5.81, p = .001$ respectively. Furthermore, a significant difference is found in students’ achievement post-test when covariate the pre-test, $F (1, 97) = 11.46, p = .001$, partial eta squared = .11. Students’ readiness can be improved when adopting the PBL techniques and activities through online learning. This approach has proven helpful, adaptable, and beneficial to learn English, especially for high school students who are forced to study online.

Keywords
online learning, problem-based learning, social constructivism, students readiness, achievement

Received 24 October 2022; accepted 16 November 2022

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Introduction

Entering the post-pandemic era, people still dare not relax their vigilance. It poses different challenges to the student achievement benefits of teaching, particularly in the primary and secondary sectors. The transition from face-to-face to online learning is currently occurring quickly and unexpectedly, especially with the global adoption of Covid-19; as a result, the preparation for online learning must be carefully taken into account in this new educational paradigm (Torun, 2019). The COVID-19 pandemic has challenged the way people work together, especially where tighter and tighter restrictions are in place (Mok et al., 2021).

Under the guidance and advice of the Ministry of Education, education departments and schools at all levels have started online teaching to avoid large gatherings of students and teachers or to maintain a state where classes are temporarily stopped but learning continues. Five departments, including the Ministry of Education and the National Development and Reform Commission, jointly issued the No. 1 document of Education Foundation (2021) which pointed out suggestions on strengthening the construction and application of online education teaching resources in primary and secondary schools. The Internet medium as the primary mode of teaching and learning remains a challenge and is usually considered a magnified role of the media in technology and the effect of education way (McCullough, 2021).

Past studies have shown that the status quo of online learning tends to be attendance, tape-broadcast courses, and lack of online teaching technology leading to inadequate preparation for online learning, and anxiety about online learning (Lin & Dai, 2022; Mok et al., 2021; Zuo et al., 2021). Dakhi et al. (2020) suggest that students become familiar with the learning environment using technology. Despite the claims of many academics, flexible interactions between students and teachers as well as between students themselves are made possible by the convergence of technology in online learning (Dakhi et al., 2020). It is necessary to give priority to appropriate teaching methods (e.g., Problem-based learning) to promote learning. New technological innovations - such as analytically personalized feedback for large-scale learning (Pardo et al., 2019) - can also enhance teacher-student interaction.

In addition, the study also shows that the learning effect is not significant, which is related to the lack of implementation of appropriate teaching methods (Mok et al., 2021; Zuo et al., 2021). For policymakers, e-learning programmers, and researchers, understanding student readiness levels and their direct and indirect effects can provide planning guidelines for better learning and student achievement (Lin & Dai, 2022). Education personnel should attach importance to the viewpoint of social constructivism, so that knowledge can be constructed from students. Effective communication improves the chances of successful learning in an e-learning environment (Yan et al., 2021) and helps students participate more successfully in classroom discussions (P. McCullough, 2021).

In this study, the PBL method is adopted to change the role of teachers into instructors, and the Tencent communication software QQ is used to communicate and publish the course content and ask appropriate questions. Through the discussion in the group function, students could group themselves and reasonably divide labor. Watch teaching videos under the conditions of existing learning platforms (national Intelligent Education cloud platform, Guizhou Province Aerial Guizhou Course), or search and collate online materials. During this process, teachers is on call to receive corresponding guidance from students through private chat. At the same time, teachers could also monitor the learning dynamics of students in each group and provided appropriate help in each discussion group.

The research investigates the effectiveness of the PBL instructional strategy with social constructivism in learning online toward the experiment group (EG) of 11-grade students of two Chinese high schools, compared with the control group (CG). The research questions of this study based on those assumptions are the following:
(1). Is there a significant difference in student readiness before and after utilizing the PBL pedagogy with social constructivism in learning online?
(2). Is there a significant difference between EG and CG in student achievement after utilizing the PBL pedagogy with social constructivism in learning online?

Literature review

Problem-Based Learning with Social Constructivism

The earliest application of PBL was in the realm of medical education in Canada (Barrows & Tamblyn, 1980; Schmitt, 2008), has been widely used in different fields and is still in the stage of continuous development and improvement since then. Researchers provided teachers with a PBL teaching strategy to cope with online teaching during the epidemic situation and set up a network environment for group communication and discussion among students with the help of constructivism (see Figure 1). The advantages of the PBL instructional technique trigger student learning and collaborative communication based on a teacher-mounted teaching framework (Berenji et al., 2020; Tang et al., 2020). It is when the teacher gives the learning setting, and the student is attracted by the problem and then searches for assessment information, building and refining the relevant information of the hypothesis in his mind.

This method is very suitable for online teaching because it is a student-centered method rather than a teacher-centered method. It pays more attention to the students themselves in the class, and the teacher becomes a scaffold in the interactive class, that knowledge is constructed by students belonging to social constructivism (Margolis, 2020). In contrast to the status quo of the Internet in the past, students do not simply watch videos, but actively research problems, apply theories and

![Figure 1. The practice framework of the problem-based learning method and social constructivism.](image-url)
exercises, and propose useful information and strategies (Baresh et al., 2019). In addition, in constructivist theory, students compile internal representations of the information they seek and interpret their own unique understandings (Aljohani, 2017). Through interactive modules, group discussions, and decentralized management of the whole group, students actively participate in the integration of the class, communicating and exploring with teachers and peers in a social constructivist environment. Social constructivism shares a broader perspective than the traditional single-teacher perspective (Amineh & Asl, 2015). Forced e-learning, changing the single output from teacher to student, expands the network into a basic link that helps students modify, develop, and shape their own data structures.

**Online Learning Readiness**

The readiness of a person to engage in learning activities in an online environment is described by the idea of online learning readiness (OLR) and the degree of students’ representation of e-learning (Liu, 2019). Aspects involving personal knowledge, cognitive learning strategies, and motivation for effective online learning styles (Yurdugül & Demir, 2017). The impact of e-learning is constrained by the readiness of the students for online learning.

Scholars have initially divided OLR into three parts: communication ability, technical ability, and social ability (Liu, 2019). The skills and sense of control needed to manage social situations, build and maintain relationships are called social competence. Communicative competence is defined as “the ability to demonstrate appropriate knowledge in a given social communication situation”. Technical competence is “the use of online learning resources and technologies in technology to improve learning quality”. Yu (2018) further divided social competence into social competence with mentors and social competence with classmates.

Studies have shown that students have a negative attitude towards learning preparation for online learning, and lack of interaction and video in the online learning environment, which leads to a sense of isolation and loneliness, leading to a sense of disconnection from the learning community (Bowers & Kumar, 2015). This could be due to the fact that many Chinese teachers are unprepared for the abrupt move to online learning or that the heavy emphasis on online learning in teaching reforms presents difficulties for many pupils (Mok et al., 2021). Therefore, improving learners’ social competence can help students to integrate academically into an e-learning environment. At the same time, communication skills also help students to seek help and peer support and learn from each other, thus improving the learning effect of online learning. Torun (2019) recommends rapid and rigorous e-readiness studies to help relevant practitioners better maintain e-learning practices.

On the contrary, online teaching also has its advantages and is praised for the smooth and relaxed atmosphere created by its structure and anonymity, especially for high school students (Zuo et al., 2021). Students also have expectations for online learning. They can favor online learning resources as well as seek timely and abundant additional learning support functions and materials (Yan et al., 2021).

**Learning Online and Achievement**

In most online teaching in China, the online learning mode of primary and middle school students is still largely imitating the teacher-centered and lecture-based face-to-face learning mode. The common teacher-student interaction modules are roll call and live chat. The more dynamic asynchronous discussions are less common, and the technology-based pop-up quizzes, project reviews, and other forms of online interaction are even rarer, suggesting that Chinese schools do not fully utilize the collaborative capabilities of online tools (Hernández-Sellés et al., 2019). A large number of students believe that this form will not improve their academic performance.
Students learning online do not receive timely and continuous guidance from teachers as they do in face-to-face classes, which will have a negative impact on their emotional health and academic performance (Niemi & Kousa, 2020; Yates et al., 2021). Sadly, the quality of instruction in online learning has greatly decreased, and most of the time, kids must deal with learning problems on their own (Barbour, 2018). Additionally, it is difficult to establish and carry out student learning plans, participate in synchronous online learning, use a variety of online learning features, and have meaningful peer interactions while doing so because of a lack of metacognitive skills (Barbour, 2018).

According to the poll, students’ grades have dramatically declined, and online instruction during the COVID-19 response has had a particularly severe effect on students’ achievement in science-related courses (Guo et al., 2022). WeChat calls, online Q&A, and live online instruction were also discovered to be well-liked supplemental teaching methods. On the other hand, a relatively small number of teachers use video recording to offer pre-recorded courses and online conferences for online teaching. In the online teaching environment, there is relatively little interaction between teachers and students (Yan et al., 2021).

On the other hand, online learning also has its advantages for academic achievement. In the evaluation of students’ online learning and ability training at the University of Hong Kong during the COVID-19 pandemic, the analysis pointed out that the effectiveness of online learning on whole-person development and active student learning would be affected by teachers’ teaching, but should not be limited to this (Mok et al., 2021). Positive interactions with peers and teachers can enhance students’ learning motivation and promote learning performance, and these interactions are beneficial to their emotional health and academic performance. Online teaching, supported by online learning practitioners, can establish students’ own learning goals, and needs, and give students the responsibility to select and implement appropriate learning strategies for students, to improve their academic results (Torun, 2019).

Methodology

Research design

A quasi-experimental research design is for demonstrating the efficacy of interventions, which is a popular and rigorous experimental methodology (Miller et al., 2020). This research investigated the effectiveness of the PBL pedagogy in learning online between EG and CG among 11-grade students’ readiness and achievement in Chinese high schools shown in Figure 2. The research site is deliberately chosen by purposive sampling (Taherdoost, 2016) because the outbreak policy is flexible and silent, and students in Guiyang were forced to continue teaching online to prevent the spread of infection. For the population, a lottery to choose two classes of students in Chinese high schools in Guiyang city, Guizhou province. And simple random sampling to choose two classes of there (Taherdoost, 2016). A fully intact class and not individuals are selected as samples.

Firstly, securing the approval of the school administration and local education department, and implementing the lesson schedule that the researcher created were based on the Grade 11 English curriculum norm for high school. The PBL intervention would be used in EG for 8 weeks, at the same time both groups are learning online. For specific interference schemes, the teacher introduces PBL teaching strategies through group messages and passes a mind map. Students voluntarily form the discussion group function of the QQ group to establish their own team. After the learning content outline is briefly introduced through ‘Tencent Classroom’, which is similar to ‘Zoom’, ‘Google Classroom’, the students grouped themselves to collect and integrate the information by recording and broadcasting, network resources, and so on. Finally, the whole class demonstrates, debates, and exchanges opinions. Different groups expressed their opinions and teachers gave timely feedback.
Duration of the data collection, the researcher sent the readiness questionnaire to the EG student in 1st and 8th weeks, which is a 5-point Likert scale adapted from Yu & Richardson (2015) directly, contains 20 items consisting of four dimensions of technical competencies, social competencies with the instructor, social competencies with classmates and communication competencies of number 6, 5, 5, 4 respectively. The last offline achievement test before the homing quarantine is to be the pre-test to ensure whether EG and CG are at the same level, and after returning to school to be post-test, with a full score of 150.

**Validation and Reliability**

For validation, these two instruments are validated by 6 experienced high school English teachers. The widely used Content Validity Index (CVI) of Polit and Beck (2006) is used to assess the content validity of multi-item scales. The term “scale-level CVI” refers to the average of the item-level CVIs after adding and dividing them by the item’s quantity. The researcher calculated the value of S-CVI as 0.93 for the readiness questionnaire and the same result is 1.00 for the achievement test, which is more than 0.90 and means high validation in these instruments (Polit & Beck, 2006).

A pilot study is conducted on 30 pupils from school X who never participated in the research to examine the instruments’ reliability. The Cronbach’s alpha value for the students’ readiness questionnaire using the Statistical Package for Social Sciences (SPSS) version 26 is 0.91, which shows high reliability because of high consistency in the range of 0.70–0.95 (Yusup, 2018).

**Results**

**Demographic Information**

The participants who are randomly selected come from high schools in Guiyang city of Guizhou province, China. 100 respondents from two intact classes formed the EG and CG used for data analysis. After data cleaning and checking the missing value, there are 100 valid respondents, and their gender and home location information are shown in Table 1. The overall gender distribution is 40% male and 60% female. In contrast, 65% of households are located in urban areas and 35% in rural areas.
**Findings of students’ readiness**

The data in Table 2 shows the mean and standard deviation of the 50 students’ readiness before the intervention in EG is \((M = 40.52, SD = 10.33)\), and on the contrary, after the intervention is \((M = 46.76, SD = 11.77)\). Additionally, neither the before nor after using PBL contains any outliers or extreme outliers.

For the normality test, the Skewness value of the before score in readiness is 65. And Kurtosis is .61, which is in the range of ±1.0, so the data is normally distributed. Similarly, the after-readiness scores of Skewness and Kurtosis are −.55 and .08, revealing the distribution is normal. In addition, the before and after scores of students’ readiness all showed the points formed a linear pattern in the Q-Q plot.

For the sub-dimensions of TC, SCI, SCC, CC of EG \((-18, 1.38), (-.07, -.48), (-.09, -.82), (-.30, -.92)\) separately and in the before are \((-1.09, -1.628), (-.04, -.40), (.68, .28), (5.0, -.19)\) respectively, those data are all in the range of ±2.0 and can do the inferential statistics. In addition, the Q-Q plot depicts a linear pattern in the four sub-dimensions scores not only before but also after the experiment.

The paired sample t-test is calculated in the readiness score and its dimensions of EG students, results show that there is a significant correlation \((r = .83)\) between the data before and after students’ learning readiness. At the same time, there are significant positive correlations between before and after the PBL teaching method with students’ technology competencies \((r = .98)\), social competencies with instructors \((r = .99)\), social competencies with classmates \((r = .40)\), and communication competencies \((r = .51)\).

**Table 1. Simple Demographic Information.**

| Category   | EG  | CG  | Total | Percent |
|------------|-----|-----|-------|---------|
| Gender     |     |     |       |         |
| Male       | 18  | 22  | 40    | 40      |
| Female     | 32  | 28  | 60    | 60      |
| Home location |   |     |       |         |
| Urban      | 41  | 24  | 65    | 65      |
| Rural      | 9   | 26  | 35    | 35      |

**Table 2. Paired Sample T-test in Students’ Readiness \((N = 50)\).**

| Statistics          | \(M\)  | \(SD\) | \(r\)  | \(Sig\) | \(M\)  | \(SD\) | \(t\)  | \(Sig\) |
|---------------------|--------|--------|--------|----------|--------|--------|--------|----------|
| Total (after)       | 46.76  | 11.77  | .83    | .001     | 6.24   | 6.51   | 6.77   | .001     |
| Total (before)      | 40.52  | 10.33  |        |          |        |        |        |          |
| TC (after)          | 16.16  | 4.59   | .98    | .001     | .20    | .81    | 1.75   | .09      |
| TC (before)         | 15.96  | 4.51   |        |          | .14    | .61    | 1.63   | .11      |
| SCI (after)         | 11.24  | 3.61   | .99    | .001     | 3.56   | 3.65   | 6.89   | .001     |
| SCI (before)        | 11.10  | 3.52   |        |          | .14    | .61    | 1.63   | .11      |
| SCC (after)         | 10.48  | 3.33   | .40    | .004     | 3.56   | 3.65   | 6.89   | .001     |
| SCC (before)        | 6.92   | 3.34   |        |          | .14    | .61    | 1.63   | .11      |
| CC (after)          | 8.88   | 2.82   | .51    | .001     | 2.38   | 2.90   | 5.81   | .001     |
| CC (before)         | 6.50   | 3.01   |        |          | .14    | .61    | 1.63   | .11      |

*Note. Total = Total score, TC = Technology competencies, SCI = Social competencies with instructor, SCC = Social competencies with classmates, CC = Communication competencies.*
The results also showed that there is a significant difference $t(49) = 6.77, p = .001$ ($p < .05$) after using the intervention, the overall score of the 50 students in the experimental group showed a positive increase of 6.24. Furthermore, the most noticeable of the scores of social competencies with classmates of EG are climbing $M = 3.56, t(49) = 6.89, p = .001$, communication competencies have a raise $M = 2.38, t(49) = 5.81, p = .001$. On the other side, the technology competencies $M = 3.56, t(49) = 6.89, p = .001$ ($p > .05$), social competencies with instructor $M = .14, t(49) = 1.63, p = .11$, are not significantly different in EG after using the PBL pedagogy in online learning, unfortunately.

**Findings of students’ achievement**

A total of 100 students participated in the examination test, and the scores (Table 3) show that the average score of the EG pre-test is 98.55, and the standard deviation is equal to 6.87, meanwhile, the mean scores and standard deviation of 50 students in the CG are 91.39, 8.84. After the intervention used in EG, there are post-test achievement scores ($M = 107.51, SD = 8.14$) in EG and ($M = 98.54, SD = 8.53$) in CG. Since there are significant differences between the pre-test scores of EG and CG, the pre-test data is taken as the co-variable for the analysis of post-test data.

The normality test of achievement pre-test in EG (Skewness = .08, Kurtosis = .36) and CG (Skewness = .32, Kurtosis = .28) shows the normal distribution in the range of ±1.0. On the other side, post-test achievement scores are normally distributed in EG (Skewness = .35, Kurtosis = -.90) and CG (Skewness = -.12, Kurtosis = 1.50) due to being in the range of ±2.0. The linear patterns are all formed in the Q-Q plot of EG and CG of achievement pre-test and post-test scores.

In Table 4, the student’s achievement on the EG and CG pre-test and post-test are compared using the MANCOVA test because pre-existing disparities between the groups are “controlled” by using the pre-test scores as a covariate. The relationship is clearly linear in the scatter plot, this

| Source     | Type III sum of squares | df | Mean square | F     | Sig    | Partial Eta squared |
|------------|-------------------------|----|-------------|-------|--------|---------------------|
| Corrected model | 7893.482^a         | 2  | 3946.741    | 913.237 | .000   | 0.95                |
| Intercept   | 68.967                 | 1  | 68.967      | 15.958  | .000   | 0.141               |
| Apre        | 5881.959              | 1  | 5881.959    | 1361.027 | .000   | 0.933               |
| Group       | 79.781                 | 1  | 79.781      | 18.461  | .000   | 0.16                |
| Error       | 419.206               | 97 | 4.322       |        |        |                     |
| Total       | 1069727.75            | 100|             |        |        |                     |
| Corrected total | 8312.687              | 99 |             |        |        |                     |

^aR Squared = .950 (Adjusted R Squared = .949).
Apre = Achievement pre-test.
assumption is fulfilled. For the dependent variable of achievement post-test of Levene’s Test of Equality of Error Variance, $F(1,98) = 1.63$ and $p$ is .21 more than .05 to meet the equal variance.

After controlling for pre-intervention scores, the Fear of Statistics Test post-intervention scores for the two intervention groups differed significantly $F(1, 97) = 18.46$, $p = .001$, partial eta squared = .16. A partial eta squared value of .93 showed that there is a significant link between the pre-intervention and post-intervention scores on the Fear of Statistics Test. With the PBL instruction in online learning, students have a positive increase in achievement.

Discussion

The results showed that the learning readiness of the students improved under the PBL method, and supports the view of Torun (2019). The system function under the PBL technique framework becomes more suitable for students’ reality and meets different students’ learning needs, such as in real-time voting, interface sharing, etc. In general, compared with watching live courses, students are not worried about the online learning form because of the lack of an interactive online course mode. The PBL teaching method integrates online learning and emphasizes the teaching technology of student-centered learning, which changes knowledge from passive absorption to active exploration and enhances learning interest. This confirms the theory of Zuo et al. (2021) and Yan et al. (2021), it stimulates students with better psychology willing to take their role in the group and actively participate in discussions online. In addition, the form of division of labor and cooperation allows textbook knowledge to be constructed by students themselves, making e-learning conducive to student readiness. This finding is associated with social constructivism (Margolis, 2020). Knowledge is constructed when social, especially for language subjects, the communication between students and the network and the discussion of components form their knowledge and deepen the influence of language learning.

Social competencies with classmates of students are conducive to this treatment. This is related to Mok et al. (2021) consistently preferring more opportunities for peer interaction. Compared with the conventional PBL teaching method, this is due to the convenience of network communication, information storage, record review, and other functions overcome the communication limitations of face-to-face learning, students are more willing to freely express their ideas. This is in line with Yan et al. (2021), that online communication is more convenient rather than offline courses.

In making joint efforts to the communication competencies, intervention plays an important increase role. The communication ability of Internet students plays the most important role in influencing their autonomous learning ability. The development of a group cooperation mode exercises students’ leadership, decision-making ability, and so on. This result provides evidence to support the study of Lin & Dai (2022). Will learn knowledge division of inquiry understanding, in collaboration to build group results. In the process, students not only learn knowledge but also develop a sense of control in managing social situations and the skills and abilities necessary to build and maintain relationships. Zuo et al. (2021) suggested that the synergistic effect of online tools should be amplified.

Admittedly, to satisfy the need for learning achievement, the experimental group showed a significant increase compared with the control group. Under the PBL instruction, students accumulate knowledge, deepen the learning effect, and improve their academic performance. This conclusion rejected the thought of Guo et al. (2022), adding interest in long-run communication, the humanization of network software reflects its advantages. Discussion groups and network resources are integrated under social constructivism, and better cohesion in the classroom atmosphere means the whole class is active. This is in line with Dakhi et al. (2020). The convenience and efficiency of the network benefit knowledge construction. At the same
time, when learning English, different expressions among students and a variety of translation software increase the possibility and diversity of students’ English learning. On the other hand, from the perspective of educators, rather than playing videos, they can better participate in the construction of classroom knowledge. They can also watch real-time, as well as search and look up what they have missed understand students’ ideas more closely. This contributes to the suggestion of Mok et al. (2021).

Conclusion

In conclusion, this study plays a positive role in both teachers’ online teaching and students’ online learning. To explore and support effective teaching strategies and skills to cope with the current domestic “dynamic zero” policy, which means schools need to shift online to prevent the spread of Covid-19, to achieve the goal of continuous learning not being interrupted due to classroom out. This study also demonstrates this point of view through experiments.

Attach great importance to the implication. PBL is an instructional technique that emphasizes student-centered learning, and high school students are given access to an engaging, flexible learning environment. The new situation has forced distance learning to become the norm in China. Teachers transfer knowledge into scaffolding for students to build knowledge independently. Pre-class guidance, and in-class guidance care, help students adapt to online learning and guide them to collaborate in building course knowledge.

Promote the recommendation. For the education department and school to give some inspiration, in view of this challenge to reform the education environment, an intelligent education cloud platform should be promoted. For teachers, the relevant training in network teaching and the continuous learning of 21st-century educational technology should be carried out to promote the cooperation mode of multi-development with the network, such as blended teaching and the application of network multimedia. For students, encourage and actively use the Internet and mobile phones to promote their multi-dimensional development, innovation ability and critical thinking.

Due to the limitations of this study, future researchers can expand the study sample and explore more detailed techniques and teaching methods that are helpful for teaching. At the same time, it is also possible to compare the different research places, because students in urban and rural areas will be affected by the infrastructure development and growth environment, resulting in a larger gap.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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References

Aljohani, M. (2017). Principles of “Constructivism” in foreign language teaching. *Journal of Literature and Art Studies, 7*(1), 1–5. https://doi.org/10.17265/2159-5836/2017.01.013
Amineh, R. J., & Asl, H. D. (2015). Review of constructivism and social constructivism. *Journal of Social Sciences, Literature and Languages*, 1(1), 9–16. [https://www.semanticscholar.org/paper/Review-of-Constructivism-and-Social-Constructivism-Amineh-Asl/38903f4a7255496f75124d639e14e9b810ce17370](https://www.semanticscholar.org/paper/Review-of-Constructivism-and-Social-Constructivism-Amineh-Asl/38903f4a7255496f75124d639e14e9b810ce17370)

Barbour, M. K. (2018). The landscape of K-12 online learning: Examining what is known. In *Handbook of distance education: Fourth edition*.

Baresh, E. F., Ali, S. M., & Darmi, R. (2019). Using Hybrid Problem-based Learning (HPBL) approach to enhance Libyan EFL students’ engagement with English language. *International Journal of Education and Literacy Studies*, 7(2), 9. [https://doi.org/10.7575/aiac.iels.v.7n.2p.9](https://doi.org/10.7575/aiac.iels.v.7n.2p.9)

Barrows, H. S., & Tamblyn, R. M. (1980). Problem-based learning: Rationale and definition. In *Problem based-learning: An approach to medical education* (1, pp. 1–18). Springer.

Berenji, S., Saeidi, M., & Ghafoori, N. (2020). The effect of problem-based learning with hard scaffolds on Iranian EFL learners’ reading comprehension. *Journal of Language and Translation*, 10(2), 121–133. [https://www.researchgate.net/publication/351274960_The_Effect_of_Problem-based_Learning_with_Hard_Scaffolds_on_Iranian_EFL_Learners%27_Reading_Comprehension](https://www.researchgate.net/publication/351274960_The_Effect_of_Problem-based_Learning_with_Hard_Scaffolds_on_Iranian_EFL_Learners%27_Reading_Comprehension)

Bowers, J., & Kumar, P. (2015). Students’ perceptions of teaching and social presence. *International Journal of Web-Based Learning and Teaching Technologies*, 10(1), 27–44. [https://doi.org/10.4018/ijwltt.2015010103](https://doi.org/10.4018/ijwltt.2015010103)

Dakhi, O., Jama, J., Irfan, D., Ambiyar, & Ishak (2020). Blended learning: A 21st century learning model at college. *International Journal Of Multi Science*, 1(7), 50–65. [https://multisciencejournal.com/index.php/ijm/article/view/92](https://multisciencejournal.com/index.php/ijm/article/view/92)

Guo, C., Xu, Z., Fang, C., & Qin, B. (2022). China survey report on the online learning status of high schools during the COVID-19 pandemic. *ECNU Review of Education*, 1(1), 1–13. [https://doi.org/10.1177/20965311221089671](https://doi.org/10.1177/20965311221089671)

Hernández-Sellés, N. (2019). Pablo-César Muñoz-Carril, & González-Sanmamed, MComputer-supported collaborative learning: An analysis of the relationship between interaction, emotional support and online collaborative tools. *Computers & Education*, 138(1), 1–12. [https://doi.org/10.1016/j.compedu.2019.04.012](https://doi.org/10.1016/j.compedu.2019.04.012)

Lin, X., & Dai, Y. (2022). An exploratory study of the effect of online learning readiness on self-regulated learning. *International Journal of Chinese Education*, 11(2), 1–10. [https://doi.org/10.1177/2212585X221111938](https://doi.org/10.1177/2212585X221111938)

Liu, J. C. (2019). Evaluating online learning orientation design with a readiness scale. *Online Learning*, 23(4), 42–61. [https://doi.org/10.24059/olj.v23i4.2078](https://doi.org/10.24059/olj.v23i4.2078)

Margolis, A. A. (2020). Zone of proximal development, scaffolding and teaching practice. *Cultural-Historical Psychology*, 16(3), 15–26. [https://doi.org/10.17759/cht.2020160303](https://doi.org/10.17759/cht.2020160303)

McCullough, P. R. (2021). De-technologizing media ecology pedagogy: A plea for tradition, practice and narrative. *Explorations in Media Ecology*, 20(2), 253–272. [https://doi.org/10.1386/eme_00090_1](https://doi.org/10.1386/eme_00090_1)

Miller, C. J., Smith, S. N., & Pugatch, M. (2020). Experimental and quasi-experimental designs in implementation research. *Psychiatry Research*, 283, 112452. [https://doi.org/10.1016/j.psychres.2019.06.027](https://doi.org/10.1016/j.psychres.2019.06.027)

Mok, K. H., Xiong, W., & Bin Aedy Rahman, H. N. (2021). COVID-19 pandemic’s disruption on university teaching and learning and competence cultivation: Student evaluation of online learning experiences in Hong Kong. *International Journal of Chinese Education*, 10(1), 1–12. [https://doi.org/10.1177/22125868211007011](https://doi.org/10.1177/22125868211007011)

Niemi, H. M., & Kousa, P. (2020). A case study of students’ and teachers’ perceptions in a finnish high school during the COVID Pandemic. *International Journal of Technology in Education and Science*, 4(4), 352–369. [https://doi.org/10.46328/ijtes.v4i4.167](https://doi.org/10.46328/ijtes.v4i4.167)

Pardo, A., Jovanovic, J., Dawson, S., Gašević, D., & Miririahi, N. (2019). Using learning analytics to scale the provision of personalised feedback. *British Journal of Educational Technology*, 50(1), 128–138. [https://doi.org/10.1111/bjet.12592](https://doi.org/10.1111/bjet.12592)
Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what’s being reported? Critique and recommendations. *Research in Nursing & Health*, 29(5), 489–497. https://doi.org/10.1002/nur.20147

Schmitt, N. (2008). Review article: Instructed second language vocabulary learning. *Language Teaching Research*, 12(3), 329–363. https://doi.org/10.1177/1362168808089921

Taherdoost, H. (2016). Sampling methods in research methodology: How to choose a sampling technique for research. *SSRN Electronic Journal*, 7(1), 1–10. https://doi.org/10.2139/ssrn.3205035

Tang, S., Long, M., Tong, F., Wang, Z., Zhang, H., & Sutton-Jones, K. L. (2020). A comparative study of problem-based learning and traditional approaches in college English classrooms: Analyzing pedagogical behaviors via classroom observation. *Behavioral Sciences*, 10(6), 105. https://doi.org/10.3390/BS10060105

Torun, E. D. (2019). Online distance learning in higher education: E-Learning readiness as a predictor of academic achievement. *Open Praxis*, 12(2), 191. https://doi.org/10.5944/openpraxis.12.2.1092

Yan, L., Whitelock-Wainwright, A., Guan, Q., Wen, G., Gašević, D., & Chen, G. (2021). Students’ experience of online learning during the COVID-19 pandemic: A province-wide survey study. *British Journal of Educational Technology*, 52(5), 2038–2057. https://doi.org/10.1111/bjet.13102

Yates, A., Starkey, L., Egerton, B., & Flueggen, F. (2021). High school students’ experience of online learning during covid-19: The influence of technology and pedagogy. *Technology, Pedagogy and Education*, 30(1), 59–73. https://doi.org/10.1080/1475939X.2020.1854337

Yu, T. (2018). Examining construct validity of the Student Online Learning Readiness (SOLR) instrument using confirmatory factor analysis. *Online Learning*, 22(4), 277–288. https://doi.org/10.24059/olj.v22i4.1297

Yu, T., & Richardson, J. C. (2015). An exploratory factor analysis and reliability analysis of the Student Online Learning Readiness (SOLR) instrument. *Online Learning*, 19(5), 120–141. https://doi.org/10.24059/olj.v19i5.593

Yurdugül, H., & Demir, Ö. (2017). An investigation of pre-service teachers’ readiness for e-learning at undergraduate level teacher training programs: The case of Hacettepe University. *Hacettepe Eğitim Dergisi*, 32(4), 896–915. https://doi.org/10.16986/HUJE.2016022763

Yusup, F. (2018). Uji validitas dan reliabilitas. *Jurnal Tarbiyah: Jurnal Ilmiah Kependidikan*, 7(1), 17–23. https://doi.org/10.18592/tarbiyah.v7i1.2100

Zuo, M., Ma, Y., Hu, Y., & Luo, H. (2021). K-12 students’ online learning experiences during COVID-19: Lessons from China. *Frontiers of Education in China*, 16(1), 1–30. https://doi.org/10.1007/s11516-021-0001-8