

Comparative study of online learning and face-to-face learning

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Abstract. Online learning is prompted by the pandemic and has become the second main learning method. Considering the differences between face-to-face (F2F) and online learning, there should be significant differences in students' learning experiences between the two learning methods. This study uses a course experience questionnaire (CEQ) and an online course experience questionnaire (OCEQ) to investigate and compare students' perceptions of two learning methods from six factors. The result indicates that the differences between the two learning methods are significant in terms of the total score of the questionnaire, the factor of good teaching (GT), the factor of clear goals (CG) and the factor of appropriate assessment (AA). The lack of social interaction on campus could be the reason for this phenomenon based on the theory of constructionism. That suggests online learning platforms and instructors take more action to increase the interactivity of online learning to motivate students. The difference in the factor of emphasis on independence is not significant, which is inconsistent with the findings from the previous study. The reason could be attributed to the increasing flexibility of the combined learning methods.

1 Introduction

Since the lockdown due to COVID-19, many face-to-face learning transited to online learning to decrease physical contact. Online learning has become increasingly prevalent [1]. Many students face two main learning methods: online and face-to-face (F2F). Online learning breaks the restriction of time and place, giving students more flexibility and opportunities to complete the course. However, previous studies have found that online learning may negatively affect student's academic performance and mental health compared with F2F learning [2]. Therefore, the issue of the comparison between online learning and F2F learning has been widely investigated by educators and psychologists to improve students' learning experiences.

2 Literature review

Online learning and F2F are two main learning methods in recent years. As an emergent tool adaptive to COVID-19, online learning has several strengths. For example, it breaks the time and space restriction for students, allowing them to have lessons outside the campus. Meanwhile, some online lessons have recordings, so students can review them whenever they want. That offers students more flexibility and opportunity to be exposed to knowledge and complete their course. Stoian et al. conducted a survey study to identify students' preferred aspects of online learning during the COVID-19 pandemic [1]. Participants in Timisoara reflected that the access to online learning material and individualised

communication with teachers are the unique benefits of online learning attracting them.

However, as a double-edged sword, online learning has some unavoidable weaknesses. One of them is the need for physical contact and interaction with instructors. Many studies have found this phenomenon among undergraduate students. For example, Kuong conducted a qualitative study through survey, interview and observation [3]. The result demonstrated that they were unsatisfied with the lack of social connection, which decreases the motivation to ask for help from classmates and decreases the sense of connectedness in the learning society. However, most participants were satisfied with the online learning experience. Unlike online learning, traditional F2F learning allows teachers and students to stay in the room and communicate face-to-face. Students can ask questions immediately when they get lost in class. Jonason et al. conducted an empirical study comparing students' ratings on a graduate online course and its F2F counterpart [4]. Students in the F2F course group reflected more positive perceptions of the instructor and course quality. Bali and Liu also compare students' perceptions of online and F2F learning methods with other indicators [5]. The result indicates that students evaluated online courses as having more social presence, social interaction and satisfaction. Mather and Sarkans conducted a qualitative study on 313 Ontario students to compare their perception of F2F and online learning in various aspects [6]. More than 60% of students reflected that they prefer the F2F learning method, though the workload in the online format is more manageable than the F2F format.

Learning experience, as a comprehended concept, has various definitions and components. Considering the

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difference between the two learning methods, students should have different perceptions of the different learning experiences. Besser and Flett researched students' subjective learning experiences due to the transition from face-to-face learning to online learning, and they referred to the learning experience as three components: affective reactions, cognitive reactions and behavioural reactions [7]. The result indicated that participants tend to have more negative (affective/cognitive/behavioural) reactions towards the necessary online format. However, Park and Kim chose learning engagement and satisfaction as indicators to represent the learning experience when they investigated the effect of students' perception of the instructor on the online learning experience [8]. The interactivity of communication tools is positively correlated with students' engagement and learning satisfaction in online learning.

This paper investigates students' overall learning experience in F2F and online learning. A survey called the Course Experience Questionnaire (CEQ), designed based on a theory framework, will be used in this study [9]. CEQ is one of the most typical and widespread instruments used to investigate university students' evaluation of teaching quality. The CEQ is based on a theory of university teaching that considers that students' approach to learning and learning quality is determined by the curriculum, instrument and assessment [10]. Compared with other indicators measuring the difference between F2F and online learning, such as academic performance, learning motivation and well-being, the learning experience is a comprehended indicator with six aspects. The learning experience is more suitable to measure pedagogical characteristics and inspire instructors to improve the teaching process.

It measures six aspects of university learning: clear goals and standards (CG), generic skills (GS), emphasis on independence (IN), good teaching (GT), appropriate workload (AW), and assessments (AA) focusing on students' understanding of course contents [10]. CEQ is originally from and widely used in the Western context. Early in 2016, Yin et al. translated the CEQ into Chinese version and used it to investigate the relationship between learning experience and course satisfaction [11]. The result indicated that CEQ is a valid instrument for investigating students' perceived teaching quality in Chinese universities.

Yin et al. modified CEQ to Online Course Experience Questionnaire (OCEQ) to adopt CEQ as a measure of online learning experience, which has been proven to have acceptable reliability and validity [12]. Yin has adopted OCEQ to explore students' engagement and learning experience [13].

This study would adopt CEQ to investigate students' F2F learning experience and OCEQ to investigate students' online learning experience. Based on the various differences between the two learning methods found in previous studies, the present study supposes there should be significant differences in learning experience regarding the six factors between online and F2F learning.

3 Method

3.1 Participants

The studies in the literature review used university students as participants. Since primary and high school students tend to have purely traditional F2F learning on campus, this study chooses university students as participants.

The researcher published the study issue on social media and invited university students to participate in this study. The interested people would direct message the researcher and the researcher would send them a link to the secure online questionnaire.

A total of 152 participants joined the study voluntarily and filled in the online questionnaire. All of them are university students and have both F2F and online learning in the last three months. Eighty of the students are males and 72 of the students are females. Their age ranged from 17 to 24 years. One hundred fifty-two students entered the Wenjuanxing platform's questionnaire webpage, and all completed and uploaded the questionnaire. Therefore, this study analysed 152 valid data.

3.2 Material

The questionnaire has two sections: demographic information and course experience questionnaire investigating students' online or F2F learning experience. The present study uses the Chinese version of the 36-item CEQ [11] that has six factors: clear goals and standards (CG, five items), generic skills (GS, six items), emphasis on independence (IN, six items), good teaching (GT, eight items), appropriate workload (AW, five items) and appropriate assessment (AA, six items). The OCEQ has six factors but has three fewer items: Item 24 in CG, Item 31 in GT, and Item 19 in AW. All the items on both CEQ and OCEQ are scored on a 4-point Likert Scale from 1 (strongly disagree) to 4 (strongly agree). CEQ and OCEQ have permitted validity to assess Chinese university student learning experience [11-13].

CG refers to students having a clear goal on what they need to learn and knowing how the knowledge would be assessed. GS refers to the transferable and practical skills students learn from the class, including but not limited to analysing problems, teamwork and communication. IN refers to the flexibility and independence in how to accomplish the course. GT refers to the perceived teaching quality of the instructor. AW refers to the workload of accomplishing the course. AA refers to the student's evaluation of the property of the assessment.

3.3 Procedures

The secured online questionnaires would include informed consent, demographic background, and the main body of the questionnaire. Meantime, participants were free to withdraw from the study at any time.

3.4 Data analysis

The secured online questionnaires would include informed consent, demographic background, and the main body of the questionnaire. This study used JASP as the analysis tool to run an internal consistency test and comparative t-test. The coefficient of Cronbach's alpha detects the internal consistency and accuracy of the questionnaire.

In this study, the independent variable is the two learning methods and the dependent variable is the different factors of learning experience measured by CEQ and OCEQ. The second analysis is an independent t-test investigating whether there is a significant

difference in six factors (CG, GS, IN, GT, AW, AA) and the total score.

4 Result

The Cronbach's alpha of CEQ and OCEQ are higher than 70, which is permitted for this study. This study compared the average scores among six factors and the total score of learning experience. One group of data IN ($W=.95$, $p<.001$) was not normally distributed so the Wilcoxon signed-rank was used in this group. Other groups were compared by paired sample t-test. The descriptive data, including mean and standard deviation, is shown in Table 1.

Table 1. Descriptive Data for Average Learning Experience Total Score and the Scores among Six Factors between F2F Learning and Online Learning

	N	Mean	SD	SE
GT-F2F-A	152	3.186	0.589	0.048
GT-online-A	152	3.171	0.652	0.053
GS-F2F-A	152	3.182	0.628	0.051
GS-online-A	152	3.136	0.710	0.058
CG-F2F-A	152	2.512	0.516	0.042
CG-online-A	152	2.276	0.334	0.027
AW-F2F-A	152	3.096	0.650	0.053
AW-online-A	152	3.041	0.683	0.055
AA-F2F-A	152	2.830	0.449	0.036
AA-online-A	152	3.128	0.699	0.057
IN-F2F-A	152	3.194	0.576	0.047
IN-online-A	152	3.109	0.717	0.058
total-F2F-A	152	17.990	2.365	0.192
total-online-A	152	16.997	2.413	0.196

Note. (GT-good teaching, GS-general skills, CG-clear goals, AW-appreciate workload, AA-appreciate assessment, IN-emphasis on independence)

There is no significant difference between the factor of the emphasis on independence (IN) between F2F learning ($M=3.2$, $SD=.58$) and online learning ($M=3.1$, $SD=.72$, $W=4700$, $p=.351$) from the Wilcoxon signed-rank test.

The result of the paired sample t-test is shown in Table 2. The difference in learning experience is significant in terms of good teaching (GT), clear goals (CG), appropriate assessment (AA) and the total score of learning experience between F2F learning and online learning. However, the difference between general skill (GS) and appropriate workload (AW) is not significant.

Participants reflected higher GT score in F2F learning ($M=3.2$, $SD=.59$) compared with online learning ($M=3.0$, $SD=.65$, $t=.28$, $p=.004$), higher CG score in F2F learning ($M=2.5$, $SD=.52$) compared with online learning ($M=2.3$, $SD=.33$, $t=5.4$, $p<.001$), higher AA score in F2F learning ($M=3.2$, $SD=.65$) compared with online learning ($M=3.0$, $SD=.65$, $t=.28$, $p=.004$). However, the difference in neither AW between F2F learning ($M=3.1$, $SD=.65$) and online learning ($M=3.0$, $SD=.68$, $t=.78$, $p=.435$), nor GS between F2F

learning ($M=3.2$, $SD=.563$) and online learning ($M=3.1$, $SD=.71$, $t=.76$, $p=.448$) is significant.

Table 2. Paired Samples T-Test for GT, GS, CG, AW, AA and the total score of F2F and online learning

F2F Learning	Online Learning	t	df	p
GT-F2F-A	- GT-online-A	0.275	151	0.004
GS-F2F-A	- GS-online-A	0.761	151	0.448
CG-F2F-A	- CG-online-A	5.407	151	<.001
AW-F2F-A	- AW-online-A	0.783	151	0.435
AA-F2F-A	- AA-online-A	-4.952	151	<.001
total-F2F-A	- total-online-A	7.735	151	<.001

Note. Student's t-test.

5 Discussion

There is a significant difference in the total mark of learning experience between the two types of learning. This finding is consistent with the deduction from previous studies. Students with different perceptions of

learning engagement and social connection in different learning methods are prone to have different learning experiences.

Participants reflect significantly higher GT and CG scores on F2F learning among six factors. This finding could be attributed to the need for more student-instructor interaction. For F2F learning, students have more physical contact with their teachers and peers, so they are prone to interact more in class, such as asking and answering class questions.

According to the theory of constructionism, children learn from their interaction with their surroundings, including instructors, peers, materials, and learning environment [14]. Personal motivational factors, learning behaviours and environmental factors can interact. Therefore, increased interaction could give students a better perception of teaching quality and a greater sense of connectivity. That would motivate students to learn more, leading to a more precise learning goal.

Based on this finding, it is rational to suggest that the online learning platform add more interactive functions to increase its interactivity, such as group discussion and role-play activities. However, considering that many platforms (TencentMeeting, Micro Teams) have been equipped with efficient interactive modules, instructors and schools could increase students' self-efficiency in joining the class activity by utilising psychology theory, such as using prizes as positive feedback. Furthermore, instructors could encourage students to reflect on their feeling about the teaching process and their goals for learning. Nevertheless, GT and CG are not direct indicators of social interaction. Thus, a more detailed exploratory survey is worthwhile to determine the reason for the significant differences in GT and CG between the two learning methods.

However, for the factor of AA, students reflect a more negative sense of F2F learning. This phenomenon is a need for more explanation from previous studies. The possible reason is that students are more comfortable with online exams because they can stay in their familiar environment, such as home and library, rather than in the classroom. The available online material gives students more opportunity to plan for their assessment with deeper thinking on how they could perform better academically without enquiring from instructors.

There is no significant difference in independence between F2F learning and online learning. This result is in contrast with the deduction from previous studies. Online learning can provide students more flexibility to address their workload, such as having the online class wherever students want and watching the recording as students need. Therefore, students should have a greater sense of independence in online classes. In this study, participants could have equal or even more independence on what and how to learn in F2F learning. In other words, the teachers in F2F learning give students more flexibility.

This study investigates whether students have different learning experiences in six different factors. The study confirms the idea that both F2F learning and

online learning have different strengths and weaknesses. Thus, considering how to combine two learning methods to improve students' learning experiences is worth discussing further. For example, Peachter and Maier surveyed 2196 university students to reflect on their preference for F2F and online learning [15]. The result identifies that when the course prioritises conceptual knowledge and the skills for applying the knowledge, students prefer F2F learning. When the course needs students to acquire self-regulated learning skills, students tend to attend online classes. There are some limitations to this study. First, this study did not explore the potential reasons behind the differences. As the lack of interaction is one of the crucial differences between online and F2F learning, further study could do a mediating analysis to investigate whether social interaction is a mediating factor between learning methods and learning experience. Second, adolescents of different ages and stages tend to have different levels of adaptability and cognitive abilities, so it is suggested to repeat this study among high school and primary school students.

6 Conclusion

In conclusion, this study uses an online survey to collect quantitative data on students' learning experience and compare whether there is a significant difference in learning experience between F2F learning and online learning. The result shows that the difference between the two learning methods is significant and some measures could be taken to improve students' online learning experience from various factors. The result suggested that the course designer increase the class student-instructor and student-student interactivity in online lessons to let students perceive higher teaching quality. In the meantime, instructors could communicate more with students to ensure that students have a clear goal during the learning process and are happy with the assessment. Meanwhile, the proper combination of F2F and online learning is worth further exploring.

References

1. C. E. Stoian, M. A. Fărcașiu, G.-M. Dragomir, and V. Gherheș. *Sustainability*. **14**, 12812, (2022).
2. S. Zhou et al. *BMC Psychiatry*. **22**, (2022).
3. H. C. Kuong. *Pr-Soc Beh Sc*. **191**, 1002–1005, (2015).
4. S. D. Johnson, S. R. Aragon, and N. Shaik. *J Int Lear Res*. **11**, 29–49, (2000).
5. S. Bali and M. C. Liu. *J Phys: Confe Ser*. **1108**, 012094, (2018).
6. M. Mather, and A. Sarkans, *Intern J Curr Instr*. **10**, 61-76, (2018).
7. A. Besser, G. L. Flett, and V. Zeigler-Hill. *Schol Teach Lear Psych*. **8**, (2020).
8. C. Park and D. Kim. *J Infor Tech Ed: Res*. **19**, 475–488, (2020).

9. J. T. E. Richardson. *Ass& Eval High Educ.* **30**, 387–415, (2005).
10. K. L. Wilson, A. Lizzio, and P. Ramsden. *Stud High Educ.* **22**, 33–53, (1997).
11. H. Yin, W. Wang, and J. Han. *High Educ.* **71**, 39–57, (2015).
12. H. Yin, G. Lu, and X. Meng. *Ass & Eval High Educ.* **47**, 1–14, (2022).
13. H. Yin. *Fut Educ Res.* 1-13, (2023)
14. Q. Cao, T. Griffin, H. Wayne, and X. Bai, *J Inform Syst Educ.* **20**, 331-338, (2009).
15. M. Paechter and B. Maier. *Intern High Educ.* **13**, 292–297, (2010).