ORIGINAL ARTICLE

Factors Affecting Students' Perceived Outcomes and Satisfaction in Virtual Classrooms

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ABSTRACT

The sudden switch from the traditional face-to-face classroom to a synchronous virtual classroom has been a challenge to universities' lecturers and students. This study aims to determine factors affecting students' perceived learning outcomes and satisfaction in the virtual mode of education. The structural equation model-based PLS technology is applied to analyze the relationships between the five factors and perceived learning outcomes and satisfaction of students who participated in online courses at three state universities in Hanoi. The study found four factors that significantly affected the students' perceived outcomes: assessment, infrastructure, interaction, and self-motivation. Three factors that influence student satisfaction are infrastructure, interaction, and lecturer knowledge and facilitation. The survey was conducted virtually at an unfavorable time so the majority of survey respondents were first-year students, which might result in biased estimates. The research findings suggest that universities should provide more technological supports for both teachers and students, re-module subjects, ensure more realistic, justified, and unbiased assessment, stimulate teachers to interact with students respectfully and flexibly, take self-motivation in consideration in course design, and provide financial support in various forms for students. The research findings contribute to a comprehensive assessment of the effectiveness of online teaching and learning in the inevitable context of the COVID-19 pandemic.

1. INTRODUCTION

In the context of the COVID-19 pandemic, colleges and universities switched from on-campus to synchronous virtual classrooms to ensure continuity of teaching and learning. 4000 responses collected from the quick survey conducted in April 2021 showed shocking facts: the smartphone was the main tool that students used to pursuit online learning due to the lack of Wi-Fi/Internet connection; there was a lack of appropriate adjustments for delivering lectures in a virtual classroom on the side of lecturers; and learning soft-wares had poor security level, specifically Zoom. The survey respondents revealed that their learning-from-home environment was substandard, which caused health problems and led to a low level of perceived outcomes and satisfaction. This fact prompted us to carry out this research to investigate the factors that determined student perceived learning outcomes and satisfaction in synchronous virtual classrooms at three state-owned higher education institutions in Hanoi.

The study begins with the literature review which is followed by the description of methodology and data. The next section is the results of the structural model and discussion. The recommendations, acknowledgment of limitations, and directions for future research are presented in the final section.

2. LITERATURE REVIEW

The increasing acceptance of online courses and online degree programs at colleges and universities are driven by advancements in information technology. Distance or online classrooms are asynchronous while virtual

classrooms may be asynchronous or synchronous, as learners and teachers appear online at the same time to facilitate immediate interactions. However, pre-recorded components such as videos, presentations, and lecture slides are also used in virtual classrooms much like in offline classrooms. Studies on online learning have widely used learners' perceived learning outcomes and satisfaction as measures of its effectiveness (Alavi et al., 1995; Graham & Scarborough, 2001).

The empirical study conducted by Volery and Lord (2000) concludes that the three critical success factors in online delivery are: technology, instructor characteristics, and student characteristics. In their work, the level of interaction is also emphasized. Peltier et al. (2003) propose a model that included factors such as instructor support and mentoring, instructor-to-student interaction, student-to-student interaction, course structure, course content, and information delivery technology. Piccoli et al. (2001) refer to human and design factors. Human factors are characterized in variables such as students' and instructors' characteristics, while design factors include technology, learner control, course content, and interaction. Eom et al. (2006) examine human factors, such as student self-motivation, students' learning styles, instructor knowledge and facilitation, instructor feedback, and design factors such as interaction and course structure and discover that they are determinants of student's perceived outcomes and satisfaction in university online education.

Technology

Technological aspects to be considered are reliability, quality, and medium richness (Sanders Lopez & Nagelhout, 1995). Network setup should be able to allow both synchronous and asynchronous exchanges, and ensure convenient access for students. The quality of the interface also plays a crucial role (Trevitt, 1995). Reeves and Harmon (1993) identify the following important dimensions of the user interface: ease of use, navigation, cognitive load, mapping, screen design, information presentation, aesthetics, and overall functionality. In medium richness theory (Daft & Lengel, 1986), medium richness allows for both synchronous and asynchronous communication and supports a variety of didactical elements. However, there are numerous softwares in online learning nowadays, so the technology our research model mainly refers to relates to the infrastructure or the platforms, technology-related support from the university side, learning resources in the university's online library, and other things out of the university control, such as Internet connection and electricity supply.

Instructor

The instructor/lecturer plays a critical role in transferring his or her knowledge to students both in traditional face-to-face and in the virtual synchronous classroom. The difference is that in a virtual classroom, the knowledge of the instructor/lecturer is transmitted to students at different locations (Leidner & Jarvenpaa, 1995). Collis (1991) suggests that not the technology, but the instructional application of the technology determines the effects of learning. According to Webster and Hackley (1997), three instructor characteristics influence online learning outcomes are: attitude toward technology, teaching style; and control over technology. Students who attend classes where instructors/lecturers are well-versed in technology are likely to experience more positive learning outcomes. In the virtual classroom, the instructor/lecturer's role is to become a facilitator, stimulator, and instructor. In the context of the COVID-19 pandemic, most education institutions in Vietnam have adopted online delivery of courses with the same content as on-site delivery in the traditional face-to-face classroom in normal times, the difference is the pace and adjustments made to fit virtual classrooms.

Student self-motivation

Student performance in virtual classrooms depends on self-regulatory capabilities. For online learning to be effective, learners must change their roles from passive learners to active learners. According to Smith (2001), self-regulated learning is self-motivation. Schunk and Zimmerman (1994) define self-motivation as the self-generated energy that gives behavioral direction toward a particular goal. The self-motivated student in a virtual classroom puts as much or more effort than in traditional face-to-face classes and can exercise self-control. Colley et al. (1994) state that many student characteristics that influence the effectiveness of online delivery are prior experience, having a computer at home, and personality-produced gender differences towards the computer. Other demographic characteristics are likely to impact the effectiveness of online delivery. Students in the virtual classroom have been imposed more responsibilities than in the traditional face-to-face class.

Interactions

Interaction within a synchronous virtual classroom is crucial to the student's satisfaction in online courses (Martin et al., 2012). The best advantage of an online synchronous virtual classroom is that faculty and students can talk to each other using text, audio, and video and express emotion using emoticons. Moore (1989) classifies interactions into three types: Learner-to-content, learner-to-instructor, and learner-to-learner. These forms of interaction in online courses are considered crucial constructs affecting online learning outcomes and student satisfaction. Learner-content interaction changes the understanding, perspectives, and cognitive structures of a learner's mind. Learner-instructor interaction seeks to stimulate, or at least maintain student interest in what is to be taught and to motivate the student to learn. Learner-to-learner interaction is an extremely valuable resource for learning. Swan (2001) reported learner-to-learner interaction was related to actual interactions in the courses, to the percentage of the course grade that is based on discussion, to required participation in discussions, and to the average length of discussion responses.

Hillman et al. (1994) introduce a fourth type of interaction, interaction with technologies, which presents the concept of learner-interface interaction and recommend instructional design strategies that will facilitate students' acquisition of the skills needed to participate effectively in the online classroom. Martin et al. (2012) suggest that student interaction, and hence learning, is aided by the live communication that occurs through the virtual classroom.

Assessment

Assessment is a critical construct determining the effectiveness of learning in a synchronous virtual classroom. It provides learners with an idea of their progress in a course, identifies their strengths and weaknesses which helps their self-adjustment to achieve their learning goals. Assessment isn't just important from a student's point of view. It serves as an instructional or pedagogical function. To be an effective component of the online classroom, assessment should be realistic. It is not easy to assess student outcomes in online learning, therefore, assessment forms should be chosen on a case-to-case basis, not just traditional assessment ones, such as essays and a multiple-choice test.

3. MATERIALS AND METHODS

Research model

Our research model illustrates the factors that potentially influence the effectiveness of synchronous virtual classrooms (Figure 1). It was devised based on the conceptual framework of previous researchers. Five sets of hypotheses are following.

H1a: The higher level of infrastructure will lead to a higher level of student agreement that the perceived learning outcomes in virtual classrooms are equal or better than in a face-to-face classroom.

H1b: The higher level of infrastructure will lead to a higher level of student perceived satisfaction.

H2a: The higher level of lecturer knowledge and a more appropriate way of lecture delivery will lead to a higher level of student agreement that the perceived learning outcomes in virtual classrooms are equal or better than in a face-to-face classroom.

H2b: The higher level of lecturer knowledge and a more appropriate way of lecture delivery will lead to a higher level of perceived satisfaction.

H3a: The student with a higher level of self-motivation will report a higher level of agreement that perceived learning outcomes in virtual classrooms are equal or better than in a face-to-face classroom.

H3b: The student with a higher level of self-motivation will experience a higher level of perceived satisfaction.

H4a: The high level of interaction will lead to a higher level of agreement that perceived learning outcomes in virtual classrooms are equal or better than in a face-to-face classroom.

H4b: The high level of interaction will lead to a higher level of perceived satisfaction.

H5a: The more realistic assessment will lead to a higher level of agreement that perceived learning outcomes in virtual classrooms are equal or better than in a face-to-face classroom.

H5b: The more realistic assessment will lead to a higher level of perceived satisfaction.
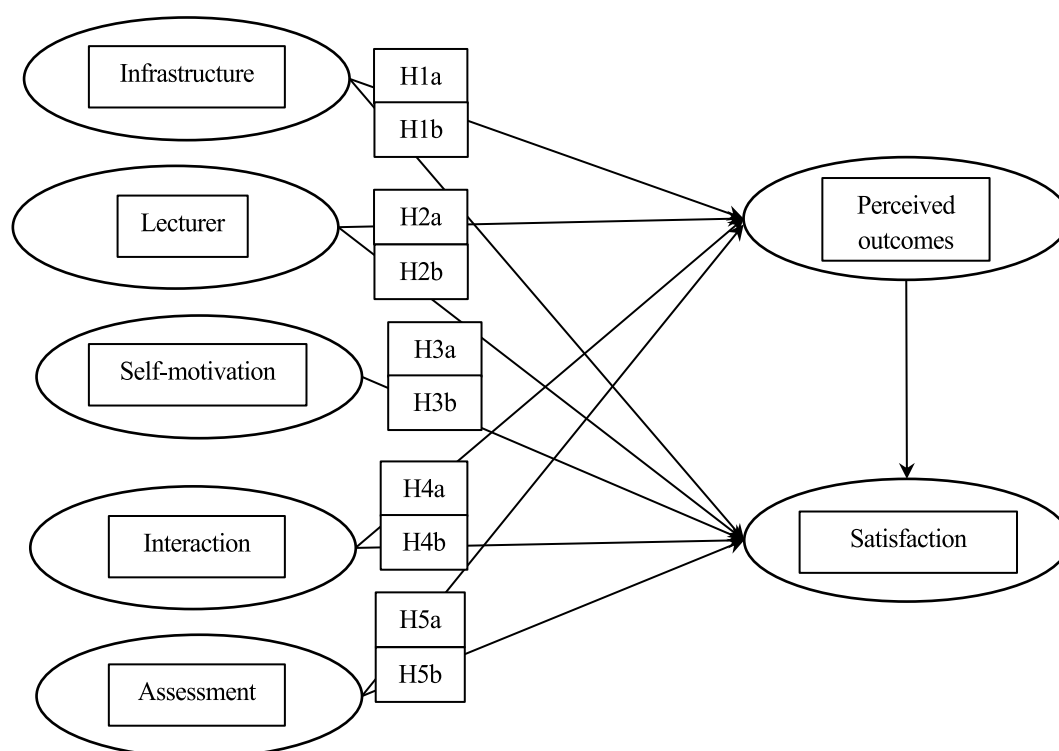
Figure 1. Research Model

Data analysis and methods

The fourth wave of the COVID-19 pandemic in Vietnam started in April 2021. Consequently, education institutions switched from the on-campus classroom into a virtual synchronous one. The sudden change in teaching and learning modality was disadvantageous for both students and lecturers/instructors. This study was conducted when online learning had been going on for two months. For many courses, the final exam was completed virtually, while for others, classroom lessons finished but the final exam had not been undertaken yet. The online delivery of lectures without sufficient preparation is disadvantageous to the effectiveness of online learning. Therefore, our research question is what factors affect the student's perceived learning outcomes and satisfaction. Answering this question will help to make recommendations for appropriate adjustments aiming at an effective virtual classroom.

Based on the literature review, we designed a questionnaire consisting of two parts. The first part concerns demographical questions, the second part consists of questions relating to 5 factors potentially influencing student perceived learning outcomes and satisfaction in a synchronous virtual classroom: infrastructure, lecturer/instructor knowledge and facilitation, student self-motivation, interaction, and assessment. The survey questionnaire welcomes other opinions as well. Respondents marked on the Likert five-point scale with increasing levels of agreement, from "Do not agree at all" to "Strongly agree".

After carrying out the pilot survey, we revised the questionnaire. It comprised 35 questions. The estimated time to complete it was from 10 to 13 min. The survey was conducted virtually through Google Forms. The Survey URL was sent to students via an email address and uploaded to student groups via social media (Facebook, Zalo, MS teams…). The survey was conducted in June and July 2021.

592 valid unduplicated responses were collected. 42 percent of the respondents were male and 58 percent were female. Most respondents are full-time students - below 25 year-old and their studies were financed by their parents. 64 percent of the respondents came from rural areas. 87 percent of the respondents stayed at home during COVID-19 waves. Most respondents, 97 percent, attended virtual classrooms via Microsoft Team. 55 percent of the respondents had two devices for online learning, which were a laptop and a smartphone. 47 percent of the respondents received support in various forms from their universities.

Our research topic belongs to an area where the relevant theory has not been well developed, so we used the structural equation model-based PLS technology to test the research hypotheses (Figure 1). The data was processed by SmartPLS 3.2.7.

4. RESULTS AND DISCUSSION

Test of the measurement model

The data analysis began with the test of the measurement model which is an estimation of the internal consistency and the convergent and discriminant validity of the instrument items. Most loadings were above 0.70 for the seven constructs, indicating individual reflective measures were reliable (Chin & Marcoulides, 1998). All reliability measures were higher than the recommended level of 0.70 (Table 1), showing that the model fulfilled requirements of adequate internal consistency (Nunnally, 1994).

Table 1. Convergent and discriminant validity of the model constructs

Variable	Factor loading
Assessment	
IC = 0.905	
AVE = 0.76	
Asse1	0.853
Asse2	0.895
Asse3	0.866
Infrastructure	
IC = 0.874	
AVE = 0.777	
Infr3	0.888
Infr4	0.875
Interaction	
IC = 0.889	
AVE = 0.8	
Inte1	0.911
Inte2	0.878
Lecturer's knowledge and facilitation	
IC = 0.903	
AVE = 0.651	
Lect1	0.789
Lect2	0.838
Lect3	0.877
Lect4	0.787
Lect5	0.738
Student Self-motivation	
IC = 0.888	
AVE = 0.728	

Moti1	0.734
Moti2	0.912
Moti3	0.901
Learning outcomes	
IC = 0.927	
AVE = 0.809	
Outc1	0.878
Outc2	0.926
Outc3	0.894
Student satisfaction	
IC = 0.914	
AVE = 0.78	
Sati1	0.859
Sati2	0.891
Sati3	0.899

IC = internal consistency; AVE = average variance extracted

Discriminant validity in this study was assessed by comparing the square root of the AVE for each construct with the correlation between the construct and other constructs in the model (Chin & Marcoulides, 1998). All constructs in the estimated model satisfied the condition of discriminant validity (Table 2).

Table 2. Correlation among construct scores (square root of AVE in the diagonal)

	Assessment	Infrastructure	Interaction	Lecturer	Self-Motivation	Outcomes	Satisfaction
Assessment	0.872						
Infrastructure	0.378	0.881					
Interaction	0.375	0.275	0.894				
Lecturer	0.628	0.483	0.36	0.807			
Self-Motivation	0.444	0.397	0.542	0.453	0.853		
Outcomes	0.524	0.367	0.351	0.373	0.404	0.900	
Satisfaction	0.428	0.329	0.335	0.284	0.333	0.808	0.883

All VIFs of the constructs < 3 (Table 3), indicating that collinearity may not be observed.

Table 3. Inner model VIF

	Assessment	Infrastructure	Interaction	Lecturer	Self-Motivation	Outcomes	Satisfaction
Assessment						1.772	2.01
Infrastructure						1.381	1.42
Interaction						1.471	1.487
Lecturer						1.932	1.936

Self-Motivation		1.685	1.711
Outcomes			1.51
Satisfaction			

Structural Model results

R^2 for dependent constructs

The results indicate that 33.2 percent of the variance in the students' perceived learning outcomes and 65.7 percent of the variance in the students' satisfaction are explained by the structural model. This percentage of variance explained above 10 percent implies satisfactory and substantive value and predictive power of the PLS model (Falk & Miller, 1992).

Structural Path Coefficient

The results of the estimated model show that four of five constructs hypothesized to affect the students' perceived outcomes were significant, which includes assessment, infrastructure, interaction, and student self-motivation, and only one was supported at *$p < 0.050$*. The lecturer's knowledge and facilitation was not significant.

The results also indicate that four of the six constructs hypothesized to affect student satisfaction were significant, suggesting that infrastructure, interaction, lecturer knowledge and facilitation, and the perceived outcomes affected student satisfaction. Of the same four constructs hypothesized to affect student satisfaction, two were supported at *$p < 0.100$*.

The estimates resulting from using bootstrapping procedure are shown in Table 4 and Figure 2 illustrating a total effect of the factors influencing dependent variables.

Table 4. Structural (inner) model results

	Path Coefficient	Observed *t* Value	Sig. Level
Effects on student perceived outcomes			
Assessment	0.397	8.377	****
Infrastructure	0.161	3.83	****
Interaction	0.105	2.294	**
Lecturer knowledge and facilitation	-0.05	1.068	ns
Student self-motivation	0.13	2.835	***
Effects on student satisfaction			
Assessment	0.018	0.471	ns
Infrastructure	0.053	1.708	*
Interaction	0.074	2.332	**
Lecturer knowledge and facilitation	-0.062	1.819	*
Student self-motivation	-0.026	0.790	ns
Perceived outcomes	0.787	32.093	****

**** *$p < .001$*, *** *$p < .010$*, ** *$p < .050$*, * *$p < .100$*.

ns = not significant

Effect size (f square)

f square indicates the effect size of independent variables on dependent variables. According to Cohen (1988), *f square < 0.02* implies an extreme small effect; *$0.02 \leq f\ square < 0.15$*: shows a small effect; *$0.15 \leq f\ square < 0.35$* indicates a medium effect; and *$f\ square \geq 0.35$*: indicates a large effect. The estimated model shows that assessment, infrastructure, interaction, lecturer knowledge, and facilitation had an extremely small effect on the student perceived

learning outcomes and satisfaction while student self-motivation had a medium effect on the student perceived learning outcomes, and an extremely small effect on the satisfaction. The students' perceived learning outcomes had a large effect on student satisfaction (Table 5 and Figure 2).

Table 5. f square

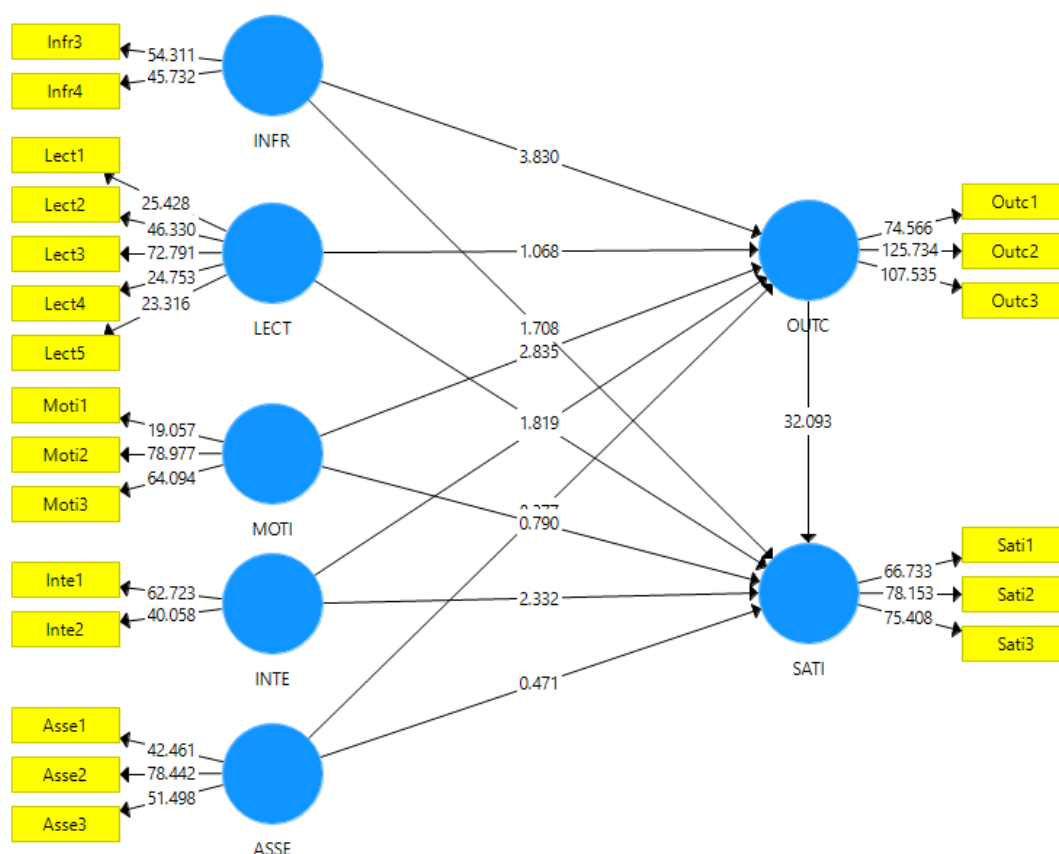|	Perceived outcomes	Student satisfaction
Assessment	0.134	0
Infrastructure	0.028	0.006
Interaction	0.011	0.011
Lecturer knowledge and facilitation	0.002	0.006
Student self-motivation	0.015	0.001
Perceived outcomes		1.208

Figure 2. Estimated model

5. CONCLUSION

The study explored the determinants of students' perceived outcomes and satisfaction in the synchronous virtual classroom. The survey data was used to test the research hypotheses through PLS analysis. Most of them received support. We found that four of five factors, assessment, infrastructure, interaction, and student self-motivation, significantly affected the students' perceived outcomes. This is partly similar to findings of previous research: students' self-motivation and interaction are similar to the study done by Eom et al. (2006), and interactions are similar to the work of Quispe-Prieto et al. (2021).

Contrary to other research findings, in our study, one factor, the effect of lecturer knowledge and facilitation on students' perceived outcomes, was insignificant. It can be explained by the fact that online learning, in a sense, is personalized and mainly requires efforts from learners, while in virtual classrooms it is too difficult for lecturers to attend to each student individually.

Three of five factors hypothesized to influence student satisfaction were supported by the data, which were infrastructure, interaction, and lecturer knowledge and facilitation. This is similar to the findings of antecedent research. Keramati et al. (2011) claim that teacher and infrastructure are crucial factors in e-learning, and the most important is a teacher. Quispe-Prieto et al. (2021) detect three similar factors affecting student satisfaction in virtual education - support, interaction, development of the study program. However, the coefficient of lecturer knowledge and facilitation had a negative sign. This result can be interpreted as a lack of proper adjustments in the way and pace that the lecture was delivered, especially for difficult or tedious subjects, thus creating pressures on students instead of giving them more support than in a traditional face-to-face classroom.

In our study, assessment and student self-motivation were found to insignificantly affect student satisfaction in a synchronous virtual classroom. Theoretically, assessments help students know what they have received, so students could self-regulate to reach their predefined target. Self-motivation can take learners far beyond fulfilling the limited requirements, as it encourages students to learn even without external reinforcements. Therefore, more research is needed to identify in what circumstances assessment and student self-motivation would affect the student satisfaction.

Practical implications

The end of the COVID-19 pandemic is uncertain. In such a context, virtual modality is the best way to maintain the continuity of learning. The objective of our study is to examine factors that affect the student's perceived learning outcomes and satisfaction. Five sets of hypotheses were tested by using structural equation modeling. Our research hypotheses received partial support from the survey data. We found four factors that determine the student perceived learning outcomes in the virtual classroom, which included assessment, infrastructure, interaction, and student self-motivation, and the three factors affecting student satisfaction were infrastructure, interaction, and lecturer knowledge and facilitation. Responses to the open-ended question show that the effectiveness of virtual education was not as expected. The reasons for that are numerous. There are reasons related to the well-being of students, e.g., insufficient equipment for online learning, and others associated with socio-economic conditions in localities - poor Internet connection quality, discontinuous electricity supply, and ineffective virtual library, 64.2 percent of the respondents lived in the rural area, 29.4 percent used smartphone in online learning, and 15 percent did not use any course resources in the Internet space. The collected data revealed a surprisingly low level of students' perceived learning outcomes and satisfaction (the mean value lies in the range of 2.485 to 2.889). Although hardship was caused by the COVID-19 pandemic, only 47 percent of the respondents received financial support from their university. Regarding limitations on the side of the lecturer/instructor, the respondents revealed that there were cases where teachers used inappropriate methods, or inappropriately handled problems such as network errors during assignment submission. In addition, the students complained that learning from home had the same tuition fees as face-to-face learning. The respondents expressed their unrest relating to the technical issues in midterm assessments, and the universities' slow reactions in deciding what form the final exam would take.

In this study, the respondents were questioned whether the five mentioned factors in a virtual class led to learning outcomes that were equal to or better than a face-to-face class. The majority of surveyed students agreed that the answer was no. This means synchronous virtual education is not universally applicable to all situations. However, virtual education is the best situational solution in the context of the COVID-19 pandemic.

To improve learning quality in a virtual classroom and to enhance student perceived learning outcomes and satisfaction, the following suggestions were proposed. *Firstly*, as shown in the model estimate, infrastructure is significantly related to the students' perceived learning outcomes and satisfaction. In most cases, the reasons for the failure of e-learning are the lack of technical support, lack of consultancy for users, and low level of usability (Soong et al., 2001). Therefore, universities should pay more attention to technological support for both teachers and students. The university's technology team should provide lecturers/instructors with technical aid to produce quality audio and professional pre-recorded videos, together with other learning resources. At the same time, troubles that happen in the teaching and learning process due to technological aspects that are out of universities' control, such as Internet connection and electricity supply, should be flexibly handled in student's interest. *Secondly*, the relationships between

interaction and students' perceived outcomes and satisfaction were statistically significant, therefore universities should re-module subjects to stimulate creative incentives for more interaction. *Thirdly*, assessment had the largest effect on students' perceived learning outcomes, so it should be reinforced and made more realistic, justified, and unbiased. *Fourthly*, the lecturer's knowledge and facilitation were significantly related to student satisfaction, however, this relationship had a negative sign. This fact could be interpreted as the lecturer's role in a virtual classroom was inappropriate, as expressed by responses such as "lecturer creating pressures". Therefore, lecturers/instructors should take on efforts to adapt to the new mode of education with an open mind, and respectfully and flexibly interact with students, especially in the evaluation of the student learning outcomes. *Fifthly*, self-motivation was one of the crucial factors influencing the students' perceived outcomes, so universities should consider this a basis for adjustment in course design. *Lastly*, financial support from universities in various forms for students is needed.

Limitations and directions for future research

Data was collected through a survey that was conducted virtually when the school year was approaching the end, so students at a higher level of their courses (the third-year, fourth-year, and fifth-year) completed their face-to-face learning and examination. Those students who took virtual classrooms did so in a short time and were insignificantly affected, so they had fewer incentives to respond to the survey. As a result, the majority of survey respondents were first-year students, who started their semester later than students at a higher level of study, when the fourth wave of the COVID-19 pandemic occurred they had to continue their semester in a synchronous virtual classroom. This might cause biased estimates.

Future research should use a sample that covers students at all levels of study. As mentioned above, this study found an insignificant relationship between lecturer/instructor and students' perceived learning outcomes, and assessment and student's self-motivation insignificantly affected student satisfaction. Therefore, future research should further investigate these insignificant relationships.

Conflict of Interest: No potential conflict of interest relevant to this article was reported.

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