

Learning Attitudes Towards and Learning Experiences in Online Teaching During the Pandemic

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Many problems with online teaching during the COVID-19 pandemic need to be solved: the unidirectional transmission of information, the immaturity of teaching platforms, the alienation in time and space between teachers and students, and the students' inconsistent learning conditions. By taking a quantitative and qualitative approach, this study explored the factors that impact students' learning attitudes and learning experiences in real-time online teaching, with the purpose of improving students' learning and future online teaching. The results show that the average scores of university students' learning attitudes and learning experiences in real-time online learning are higher than the standard scores. Moreover, significant differences have been found in gender, the availability of independent learning space, the parents' requirements, discipline, and grade. Online teaching has increased students' academic workload and brought great challenges to students' attention, self-regulated learning abilities, as well as physical and mental health.

Keywords: real-time online teaching, learning attitude, learning experience

INTRODUCTION

Thanks to the Internet technologies, online communication and online conferences have greatly facilitated the reform of higher education (Garrison & Kanuka, 2008). In particular, the past two decades have witnessed the increasing popularity of online learning in higher education due to its flexibility and openness (Zawacki-Richter & Naidu, 2016). However, according to the findings on asynchronous online teaching such as MOOCs, online learning still bears a lot of limitations, including the failure to provide flexible access and cost-effective interactive learning quality (Kanuka & Brooks, 2010). During the COVID-19 pandemic in 2020, the full-scale real-time online teaching has been practiced across the world. The effects of such online teaching, however, are unsatisfactory at different levels.

A number of studies (e.g. Adnan, 2020; Mailizar et al., 2020) have explored the benefits and challenges of online learning during the pandemic from various perspectives. What is common and notable in these studies is that students' voices are particularly important regarding online learning. It is argued that future studies should investigate into students' views on the challenges as well as the ways to better achieve their learning goals (Mailizar et al., 2020; Basilaia & Kvavadze, 2020). In this sense, it will be both illuminating and constructive to observe students' online learning attitudes (LA) and their learning experiences (LE).

With students from Shanghai Jiao Tong University (SJTU) as the participants, this study explored into the factors that impact university students' online LA and their LE by psychometric tools. First of all, we will present definitions of the key terms and the hypotheses.

DEFINITIONS AND THE HYPOTHESES

Learning Attitude

Learning attitude, according to Freedman (1981), is the consistent cognitive assessment, emotional feeling, and behavioral inclination of individuals towards a certain learning object. The propensity to respond can be either positive (e.g. appreciation and satisfaction) or negative (e.g. disgust and rejection) (Freedman, 1981). As such, LA consists of three major components: cognitive assessment (curriculum effect and value), emotional feeling (like or dislike) and behavioral inclination. The three components are unified into one strand, and in instances where the three components diverge, the emotional component holds a dominant position, determining the basic orientation and behavioral inclination of LA.

Previous studies revealed that students from different majors may show different attitudes towards online learning: negative, positive or both (Maja et al., 2020). The overall LA of students is positive after completing one semester of online learning (Zhu et al., 2020). The use of online homework platform has a positive effect on students, such as facilitating students' understanding of the concepts covered, providing them with timely feedback, and increasing their chances of completing the courses (Malik et al., 2014; Salame & Hanna, 2020). In return, the LA would have an impact on students' planning, commitment and willingness to learning online (García Botero et al., 2018). Therefore, online learning can be seen to lead to both a negative and a positive attitude towards learning, and such a positive or a negative attitude towards online learning determines their learning effects (Sanders & Morrison-Shetlar, 2001).

Learning Experience

Online LE may include both the use of online tools and the view of using these tools (Ma. et al., 2016). Specific factors affecting the LE of students may be explored (Jiang et al., 2019; Paechter et al., 2010). Generally speaking, the LE in the intelligent learning environment includes the experience brought by information technology (natural objective object), learning space (artificial objective object) and teaching method (subjective object) (Hu and Huang, 2016). Information technology consists of equipment acquisition, resource acquisition, and content presentation; learning space consists of physical environment and seat layout; and teaching method consists of human-to-human interaction, human-to-computer interaction, teaching activities, and support for learning. The LE in online real-time teaching may also include the feelings of students about their own academic achievement.

Current research on the online LE focuses primarily on the MOOCs courses. A problem is that online learning makes conventional assessment methods no longer effective (Zutshi et al., 2013). Thus, there is a gap between online learning theories and their implementations, which leads to the instability of online learning performance. Online learning is still questionable to many students while academic circles and front-line educators have demonstrated their excitement and commitment to online learning (e.g. Chapman et al., 2010; Ayu, 2020).

The good news is that some other studies found favorable results for online learning. For instance, students in Kuwaiti are found to believe that online learning is more interesting than traditional teaching (Elango et al., 2008). It is true that live streaming and shared dialogue between learners in the online classroom can help enrich the experience of online learning. Other variables, such as the gender, discipline, grade, region, type of university, and proficiency of teachers and students in using different online teaching platforms, are also critical to online LE of university students (Teng et al., 2012). Flexible implementation of the class will enhance the students' LE and learning behavior and enable them to obtain better grades, thus reducing the effect on grades of individual differences (Schwarzenberg et al., 2018).

Previous research on online learning environments concentrated on MOOCs and small-scale online learning in non-real-time mode, such as flipped courses. Those students who take the initiative to learn by means of MOOCs, however, have very strong intrinsic motivation for learning. The reason why they choose to study such courses is out of their interests in the subject, eagerness to improve their skills and satisfying their curiosity (Belanger & Thornton, 2013). In view of this, the findings from those researches cannot be used to adequately solve the problems caused by the COVID-19 pandemic, during which online teaching is simultaneously large-scale and real-time.

Research Hypothesis

Taking into consideration the factors such as the mandatory online real-time teaching during the pandemic, the lack of training and online teaching experiences of teachers, immature online learning environments, and students' poor learning motivation, we propose the following two hypotheses:

- 1) *Students' LA and LE are not good in real-time online learning environment.*
- 2) *The effect of real-time online teaching on the LA and LE of students will display significant difference in gender, grade, the availability of independent learning space, and parents' monitoring.*

METHODS

Research Design

The undergraduate, graduate and doctoral students from SJTU who studied online in the spring semester of 2020 were taken as the participants. During the pandemic, four major online teaching approaches were adopted by SJTU: online live teaching; "recording and playing" teaching by which teachers record lectures prior to the class (similar to MOOCs) and students were required to watch them before each class; teaching with MOOCs by which teachers provided the MOOC resources and then carried out the teaching activities during the class; seminar teaching by which teachers prepared PPT slides and other learning materials before class and stored them on the digital platform for students to review before class. The university also provided teachers with the Canvas teaching platform, which allowed them to share teaching materials and conduct interactions.

Meanwhile, through the ZOOM platform, the teaching schedules for each class (e.g. the time and classroom) were arranged as meetings. The university provided teachers with several rounds of training on platform features and functionalities before formal teaching. Each teacher was required to do a demo class a week before the real class began. A supervisor would help ensure that each teacher performed the online teaching adeptly. Supervisors were assigned to attend classes in separate ZOOM classrooms at random every week after the official launching of online teaching. Teaching assistants were assigned for dealing with possible technical problems.

To test the effectiveness of such real-time online teaching, we prepared a self-designed questionnaire on LA and LE and did a survey after three and a half months of online learning. An open-ended question was designed in the questionnaire for students' qualitative feedback so as to include questions that might not be covered. The independent variable is online teaching, and the dependent variable is students' LA and LE.

Instruments

Two self-designed questionnaires as follows were used to investigate LA and LE of students.

Learning Attitude Questionnaire

Based on Friedman's ABC attitude model on the divisions of attitude, the Learning Attitude Questionnaire (LAQ) was compiled on the basis of responses from 907 SJTU students to the open-ended question "What do you feel about online teaching?". LAQ comprises three dimensions: cognition, emotion and behavior. The pilot questionnaire consisted of 19 items with the 7 Point Likert Scale. Altogether 10 postgraduates majoring in higher education and 6 experts engaged in educational research were paid to assess the validity of the dimensions and the items of the pilot questionnaire. With feedback, the item "I like learning better now" was rephrased into "I am more self-disciplined in my learning". Students took several courses at the same time and thus there must have been some courses that they liked and some courses they disliked. This item was then deleted in the final version. The same is true to the item "I like teachers more", which was deleted too. With such screening, in the final LAQ, only 17 items were retained. The reliability coefficients of the LAQ are higher than 0.75, indicating that the reliability is good (See Table 1).

TABLE 1
RELIABILITY OF LEARNING ATTITUDE QUESTIONNAIRE

Dimensions	Cronbach's alpha	Normalized Cronbach's alpha	Items
Cognitive dimension	.859	.860	7
Emotional dimension	.754	.754	3
Behavioral dimension	.899	.899	7
Total	.948	.947	17

Learning Experience Questionnaire

The design of the Learning Experience Questionnaire (LEQ) was based on the defining concept of teaching experience as demonstrated above. The pilot LEQ was developed based on the responses from 907 students to the open-ended questions, comprising 33 items. Similarly, we adopted the 7 Point Likert Scale. Altogether 16 higher education professionals were paid to assess the validity of the pilot questionnaire. According to the assessment results, 8 items were deleted, and thus 25 items were retained in the final LEQ. The factor analysis showed that 50.77% of the total variance can be explained after removing two primary factors. We identified these two variables as the learning-related experience dimension (including 16 items) and the environment-related experience dimension. The reliability coefficients of LEQ are higher than 0.75, suggesting that the reliability is good (See Table 2).

TABLE 2
RELIABILITY OF LEARNING EXPERIENCE QUESTIONNAIRE

	Cronbach's alpha	Normalized Cronbach's alpha	Items
Learning-related experience dimension	.939	.941	16
Environment-related experience dimension	.838	.839	9
Learning Experience Questionnaire	.904	.894	25

Data Collection and Processing

A total of 3,200 students were examined, ranging from undergraduates, graduates to doctoral students, from 18 schools at SJTU. A total of 3034 questionnaires were collected, with a 94.8 % collection rate. Among these questionnaires, 2702 (84.4 %) are valid and 332 are invalid (e.g. incomplete answers). The participants included a total of 1973 males and 729 females. Also, 592 qualitative feedback answers were collected from the open-ended questions, accounting for 22% of the valid questionnaires. To examine the data, SPSS 24.0 was used.

RESULTS

The Intrinsic Differences in LA and LE

The results show that the LA and LE of students in real-time online teaching is different from expectations, and this is partially in line with our first research hypothesis. The reason may be that a number of factors affect real-time online teaching: the advantages and disadvantages of it, the features of different courses, the quality of teaching platform, the teaching abilities of instructors, the technical level and investment, the learning style, and learning environment, etc.

Characteristics of LA in Real-Time Online Teaching

The features of students' LA in real-time online teaching can be summarized and shown in as follows (See Table 3).

- 1) The LA of some students have been significantly improved. According to the results, 25% of the students report they are more interested in doing homework due to online teaching; 40.4% of them have increased their initiative in doing homework, and 33.4% of them have willingly spent more time in doing homework. With respect to class interaction, 49.5% of the students prefer to engage in class interaction online, and 44.4% of them participate in class interaction more actively and regularly. The proportion of likes and dislikes is 44.1% to 38% in terms of online teaching. Qualitative feedback also shows that some learners do not like online courses, with more than 220 feedback voicing directly their dislikes of online courses. For example, "I do not like online courses" (#342¹).
- 2) The side effects of real-time online teaching make most students appreciate the hard work of teachers and therefore offer more positive evaluations to teachers. 66.7% of the students appreciate the efforts of teachers more than before. In their qualitative feedback, students note that "Through online teaching we can better appreciate teachers' hard work" (#70). In addition, 69.7% of the students have a more accommodating and understanding attitude towards the occasional errors or shortcomings of teachers during the class. 72.4% of them believe that the teachers have taught them the core part of the lessons. 81% of them agree that teachers are very responsible.
- 3) Students' self-regulated learning ability has been exercised, and their motivation has been enhanced. Up to 62.5% of them agree that their self-regulated learning abilities have been practiced through one semester of online learning; 45.9% of the students show stronger motivation to discuss those questions they did not understand during online teaching.
- 4) It is difficult for students to keep continuous concentration in online courses because of the unidirectional information transmission. The learning environment affects the learning quality of some students, and 44% of the students complain that when attending lectures online it is difficult to maintain the attention for a long time, and 53.4% of them feel that the family environment is not suitable for learning. These results are consistent with qualitative feedback from the students. 32.6% of the respondents anticipate that the outcomes of their final exams would not be satisfactory. More than 140 qualitative feedbacks mention that there is no learning atmosphere at home, and in online courses the students feel less self-disciplined.

TABLE 3
DESCRIPTIVE STATISTIC RESULTS OF THE LEARNING ATTITUDE QUESTIONNAIRE

Questionnaire items		SD	D	SoD	NA	SoA	A	SA	Total
<i>Doing homework has become a pleasure.</i>	Frequency	356	372	450	848	306	216	154	2702
	Percentage	13.2	13.8	16.7	31.4	11.3	8.0	5.7	100.0
	Cumulative percentage	13.2	26.9	43.6	75.0	86.3	94.3	100.0	
<i>It feels good to participate in classroom interaction.</i>	Frequency	158	191	379	636	589	475	274	2702
	Percentage	5.8	7.1	14.0	23.5	21.8	17.6	10.1	100.0
	Cumulative percentage	5.8	12.9	26.9	50.5	72.3	89.9	100.0	
<i>I like online courses.</i>	Frequency	315	287	425	483	471	405	316	2702
	Percentage	11.7	10.6	15.7	17.9	17.4	15.0	11.7	100.0
	Cumulative percentage	11.7	22.3	38.0	55.9	73.3	88.3	100.0	

<i>I cherish the teachers' hard work even more.</i>	Frequency	57	66	135	642	685	645	472	2702
	Percentage	2.1	2.4	5.0	23.8	25.4	23.9	17.5	100.0
	Cumulative percentage	2.1	4.6	9.5	33.3	58.7	82.5	100.0	
<i>I'm more tolerant of teachers' mistakes and shortcomings.</i>	Frequency	46	59	83	631	666	714	503	2702
	Percentage	1.7	2.2	3.1	23.4	24.6	26.4	18.6	100.0
	Cumulative percentage	1.7	3.9	7.0	30.3	55.0	81.4	100.0	
<i>I'd like to explore the problems I don't understand.</i>	Frequency	124	177	329	833	562	436	241	2702
	Percentage	4.6	6.6	12.2	30.8	20.8	16.1	8.9	100.0
	Cumulative percentage	4.6	11.1	23.3	54.1	74.9	91.1	100.0	
<i>My participation in classroom interaction has increased.</i>	Frequency	180	222	305	795	551	413	236	2702
	Percentage	6.7	8.2	11.3	29.4	20.4	15.3	8.7	100.0
	Cumulative percentage	6.7	14.9	26.2	55.6	76.0	91.3	100.0	
<i>I am more motivated to do homework.</i>	Frequency	162	214	353	882	493	367	231	2702
	Percentage	6.0	7.9	13.1	32.6	18.2	13.6	8.5	100.0
	Cumulative percentage	6.0	13.9	27.0	59.6	77.9	91.5	100.0	
<i>I am more focused during classes.</i>	Frequency	239	319	632	640	391	300	181	2702
	Percentage	8.8	11.8	23.4	23.7	14.5	11.1	6.7	100.0
	Cumulative percentage	8.8	20.7	44.0	67.7	82.2	93.3	100.0	
<i>I voluntarily invested more time in studying.</i>	Frequency	148	269	402	709	548	356	270	2702
	Percentage	5.5	10.0	14.9	26.2	20.3	13.2	10.0	100.0
	Cumulative percentage	5.5	15.4	30.3	56.6	76.8	90.0	100.0	
<i>I think the school arrangement has done the best.</i>	Frequency	107	124	237	378	638	713	505	2702
	Percentage	4.0	4.6	8.8	14.0	23.6	26.4	18.7	100.0
	Cumulative percentage	4.0	8.5	17.3	31.3	54.9	81.3	100.0	
<i>I'm sure learning at home is better.</i>	Frequency	422	396	626	537	312	229	180	2702
	Percentage	15.6	14.7	23.2	19.9	11.5	8.5	6.7	100.0
	Cumulative percentage	15.6	30.3	53.4	73.3	84.9	93.3	100.0	
<i>I think the teachers have taught us the most important knowledge.</i>	Frequency	59	47	114	526	651	796	509	2702
	Percentage	2.2	1.7	4.2	19.5	24.1	29.5	18.8	100.0
	Cumulative percentage	2.2	3.9	8.1	27.6	51.7	81.2	100.0	
<i>I think I will get an ideal</i>	Frequency	228	223	430	749	477	381	214	2702
	Percentage	8.4	8.3	15.9	27.7	17.7	14.1	7.9	100.0

<i>grade in the final exam.</i>	Cumulative percentage	8.4	16.7	32.6	60.3	78.0	92.1	100.0	
<i>I think my independent learning ability has been well trained.</i>	Frequency	121	120	217	556	731	581	376	2702
	Percentage	4.5	4.4	8.0	20.6	27.1	21.5	13.9	100.0
	Cumulative percentage	4.5	8.9	17.0	37.5	64.6	86.1	100.0	
<i>I think the level of learning is moderate.</i>	Frequency	100	150	335	792	585	487	253	2702
	Percentage	3.7	5.6	12.4	29.3	21.7	18.0	9.4	100.0
	Cumulative percentage	3.7	9.3	21.7	51.0	72.6	90.6	100.0	
<i>I think the teachers are very responsible.</i>	Frequency	47	36	77	354	547	867	774	2702
	Percentage	1.7	1.3	2.8	13.1	20.2	32.1	28.6	100.0
	Cumulative percentage	1.7	3.1	5.9	19.0	39.3	71.4	100.0	

Key: SD: strongly disagree; D: disagree; SoD: somewhat disagree; NA: neither disagree nor agree; SoA: strongly agree; A: agree; SA: strongly agree

Characteristics of LE in Real-Time Online Teaching

The characteristics of university students' LE in real-time online teaching can be summarized as follows (See Table 4).

- 1) Online teaching has significantly improved the effectiveness of learning, communication and extracurricular development. 44.6% of the respondents agree that the learning quality has been improved; 63.4% of them state that it is easier to interact with teachers in online learning; 69.2% of them believe that online teaching provides better access to teaching materials; 66.8% of them consider that online homework feedback is more timely; 51.7% of them express that online teaching gives them more chances to share ideas, and 75.9% of them say that they have better self-control and timing. The qualitative feedbacks also show similar viewpoints.
- 2) Online teaching improves the learning qualities and class interaction effects of a number of students. 43.4% of the respondents believe that teachers have improved their understanding of what and how students feel; 59.3% of them think that online teaching enables teachers to adjust the pace and content of courses in time according to students' reactions; 66.3% of them feel that teachers' interactive ways in online teaching are more diverse; 46.9% of them feel that the course content of online teaching is more interesting, and 40.1% of them think that the content in online teaching is in line with their expectations. In addition, 49.3% of the students think that the teachers' time utilization rate in online teaching has been significantly improved, and 41.7% of them think that the curriculum is more reasonable. Qualitative feedback also shows that online teaching helps overcome the problem of not being able to see the blackboard or to hear clearly in classes. Moreover, online teaching encourages shy students to express and ask questions by simply typing in their questions directly.
- 3) Students show contradictory opinions on different online course modes. For instance, 52.3% of them feel that previewing learning materials before class and discussions during the class enable them to better understand the key points. 69.2% of them agree that in some classes, online teaching is more successful. However, some students are not satisfied with the class mode and platform functions. The qualitative feedback of the respondents is in line with the similar experience. As to group discussion, 53.3% of the respondents feel that the effect of online group discussion is very poor. A qualitative feedback says: "The homework in the form of online group tasks is particularly inefficient and energy-consuming." (#1899). Altogether 664 students in the large class teaching and small class discussion mode, accounting for 24.6%

of the total, feel that there is a mismatch between what they have learned online and their homework assigned.

- 4) Some teaching environment issues such as online teaching platform, equipment and network have caused trouble for many students. 23.2% of the respondents complain that it takes too long to submit their homework. 59.1% of them think that multiple teaching platforms and notification channels add burden to their learning, and 51.5% of them mention that the submission platforms, methods and requirements for homework are inconsistent and confusing. The qualitative feedback also includes similar views.
- 5) Online teaching raises the academic workload of students, and brings great challenges to their concentration, and to self-regulated and adaptive learning capabilities. Since online exams are still problematic in many ways, teachers lower the percentage of final exam results and correspondingly increase the amount of homework and the percentage of grading during class. As such, 56% of the students believe that online teaching has led to a huge increase in the amount of schoolwork, and 50 qualitative feedbacks express dissatisfaction with the assignments.
- 6) Studying in front of the computer screen for a long time has adverse effects on students' physical and mental health. On the one hand, it does damage to students' eyes; and on the other hand, there is no interpersonal contact. Furthermore, the self-denial triggered by lack of self-discipline has a detrimental effect on the mental health of students. 57.3% of the students found it unbearable to look all day long at the screen. 23 qualitative feedbacks specifically mention discomfort in eyes, and 19 feedbacks explicitly mention fatigue.
- 7) Some other suggestions in relation to the improvement of online teaching are also given in students' qualitative feedback. For example, 15 feedbacks suggest that experimental classes and practical classes are not supposed to be conducted online; some students question the utility of online communication. They say that "You may not get the response in time from the teacher in the online courses since they may not check the messages." (#772). Some students believe that it is difficult for teachers to track the learning activities of students in online courses in time.

TABLE 4
DESCRIPTIVE STATISTICAL RESULTS OF THE LEARNING EXPERIENCE
QUESTIONNAIRE

Question items		SD	D	SoD	NA	SoA	A	SA	Total
<i>Online teaching has improved my learning efficiency.</i>	Frequency	235	264	463	806	473	281	180	2702
	Percentage	8.7	9.8	17.1	29.8	17.5	10.4	6.7	100.0
	Cumulative percentage	8.7	18.5	35.6	65.4	82.9	93.3	100.0	
<i>Online teaching facilitates my communication with teachers.</i>	Frequency	128	135	282	714	681	514	248	2702
	Percentage	4.7	5.0	10.4	26.4	25.2	19.0	9.2	100.0
	Cumulative percentage	4.7	9.7	20.2	46.6	71.8	90.8	100.0	
<i>Access to teaching materials is more convenient.</i>	Frequency	101	97	162	473	648	687	534	2702
	Percentage	3.7	3.6	6.0	17.5	24.0	25.4	19.8	100.0
	Cumulative percentage	3.7	7.3	13.3	30.8	54.8	80.2	100.0	
<i>The burden of schoolwork has been reduced a lot.</i>	Frequency	600	440	474	690	250	166	82	2702
	Percentage	22.2	16.3	17.5	25.5	9.3	6.1	3.0	100.0
	Cumulative percentage	22.2	38.5	56.0	81.6	90.8	97.0	100.0	

<i>The feedback on online work is more timely.</i>	Frequency	120	134	226	686	679	544	313	2702
	Percentage	4.4	5.0	8.4	25.4	25.1	20.1	11.6	100.0
	Cumulative percentage	4.4	9.4	17.8	43.2	68.3	88.4	100.0	
<i>The teacher knows our feelings better.</i>	Frequency	154	161	343	872	586	379	207	2702
	Percentage	5.7	6.0	12.7	32.3	21.7	14.0	7.7	100.0
	Cumulative percentage	5.7	11.7	24.4	56.6	78.3	92.3	100.0	
<i>Teachers can adjust the pace and content of the course more timely according to students' responses.</i>	Frequency	89	123	209	679	765	535	302	2702
	Percentage	3.3	4.6	7.7	25.1	28.3	19.8	11.2	100.0
	Cumulative percentage	3.3	7.8	15.6	40.7	69.0	88.8	100.0	
<i>I have more opportunities to express my opinions.</i>	Frequency	112	117	213	890	679	482	209	2702
	Percentage	4.1	4.3	7.9	32.9	25.1	17.8	7.7	100.0
	Cumulative percentage	4.1	8.5	16.4	49.3	74.4	92.3	100.0	
<i>The interaction between teachers and students is more diverse.</i>	Frequency	106	122	239	713	756	501	265	2702
	Percentage	3.9	4.5	8.8	26.4	28.0	18.5	9.8	100.0
	Cumulative percentage	3.9	8.4	17.3	43.7	71.7	90.2	100.0	
<i>Overall, I think the course content is more interesting.</i>	Frequency	140	169	246	1150	476	326	195	2702
	Percentage	5.2	6.3	9.1	42.6	17.6	12.1	7.2	100.0
	Cumulative percentage	5.2	11.4	20.5	63.1	80.7	92.8	100.0	
<i>The content taught by the teacher is more in line with my expectations.</i>	Frequency	89	108	238	1174	506	386	201	2702
	Percentage	3.3	4.0	8.8	43.4	18.7	14.3	7.4	100.0
	Cumulative percentage	3.3	7.3	16.1	59.5	78.3	92.6	100.0	
<i>I have more free time.</i>	Frequency	173	163	173	413	705	637	438	2702
	Percentage	6.4	6.0	6.4	15.3	26.1	23.6	16.2	100.0
	Cumulative percentage	6.4	12.4	18.8	34.1	60.2	83.8	100.0	
<i>Overall, the teacher's time utilization in the classroom has been significantly improved.</i>	Frequency	112	124	271	863	631	451	250	2702
	Percentage	4.1	4.6	10.0	31.9	23.4	16.7	9.3	100.0
	Cumulative percentage	4.1	8.7	18.8	50.7	74.1	90.7	100.0	
<i>The curriculum is more reasonable.</i>	Frequency	133	128	274	1040	550	357	220	2702
	Percentage	4.9	4.7	10.1	38.5	20.4	13.2	8.1	100.0
	Cumulative percentage	4.9	9.7	19.8	58.3	78.6	91.9	100.0	
<i>The pre-class preparation, the way of discussion or explanation in class allows me to better grasp the key points.</i>	Frequency	97	104	216	871	657	508	249	2702
	Percentage	3.6	3.8	8.0	32.2	24.3	18.8	9.2	100.0
	Cumulative percentage	3.6	7.4	15.4	47.7	72.0	90.8	100.0	

<i>Some courses will be more efficient by using online teaching (such as ideological and political courses).</i>	Frequency	97	103	113	519	689	613	568	2702
	Percentage	3.6	3.8	4.2	19.2	25.5	22.7	21.0	100.0
	Cumulative percentage	3.6	7.4	11.6	30.8	56.3	79.0	100.0	
<i>It takes longer to submit the assignment than to do the assignment.</i>	Frequency	424	567	399	685	359	150	118	2702
	Percentage	15.7	21.0	14.8	25.4	13.3	5.6	4.4	100.0
	Cumulative percentage	15.7	36.7	51.4	76.8	90.1	95.6	100.0	
<i>Watching the videos offline and playing the videos again online is a waste of time.</i>	Frequency	194	279	328	802	537	331	231	2702
	Percentage	7.2	10.3	12.1	29.7	19.9	12.3	8.5	100.0
	Cumulative percentage	7.2	17.5	29.6	59.3	79.2	91.5	100.0	
<i>There is a mismatch between what they teachers teach online and the assigned homework.</i>	Frequency	279	415	353	991	369	182	113	2702
	Percentage	10.3	15.4	13.1	36.7	13.7	6.7	4.2	100.0
	Cumulative percentage	10.3	25.7	38.7	75.4	89.1	95.8	100.0	
<i>Online group discussions are not effective.</i>	Frequency	98	180	272	712	675	444	321	2702
	Percentage	3.6	6.7	10.1	26.4	25.0	16.4	11.9	100.0
	Cumulative percentage	3.6	10.3	20.4	46.7	71.7	88.1	100.0	
<i>It is hard to keep learning.</i>	Frequency	167	265	290	940	586	273	181	2702
	Percentage	6.2	9.8	10.7	34.8	21.7	10.1	6.7	100.0
	Cumulative percentage	6.2	16.0	26.7	61.5	83.2	93.3	100.0	
<i>Frequent failures of online platforms make me unbearable.</i>	Frequency	195	363	331	717	612	275	209	2702
	Percentage	7.2	13.4	12.3	26.5	22.6	10.2	7.7	100.0
	Cumulative percentage	7.2	20.7	32.9	59.4	82.1	92.3	100.0	
<i>I can't stand staring at the computer every day.</i>	Frequency	128	219	222	586	692	432	423	2702
	Percentage	4.7	8.1	8.2	21.7	25.6	16.0	15.7	100.0
	Cumulative percentage	4.7	12.8	21.1	42.7	68.4	84.3	100.0	
<i>Multiple teaching platforms and notification channels greatly increased the complexity of learning.</i>	Frequency	119	174	185	626	742	485	371	2702
	Percentage	4.4	6.4	6.8	23.2	27.5	17.9	13.7	100.0
	Cumulative percentage	4.4	10.8	17.7	40.9	68.3	86.3	100.0	

<i>Homework submission platforms, methods and requirements are chaotic and confusing.</i>	Frequency	152	256	258	644	688	398	306	2702
	Percentage	5.6	9.5	9.5	23.8	25.5	14.7	11.3	100.0
	Cumulative percentage	5.6	15.1	24.6	48.5	73.9	88.7	100.0	

Key: SD: strongly disagree; D: disagree; SoD: somewhat disagree; NA: neither disagree nor agree; SoA: strongly agree; A: agree; SA: strongly agree

Factors That Impact LA and LE

The LA and LE of university students in real-time online teaching may be influenced by many factors, among which are gender, grade, school, the availability of independent learning space, and parents' monitoring.

Gender Differences

Students of different gender have different LA and LE. The normal distribution test indicates that the skewness values of LA and LE for female students are .002 and .003, respectively, and those of males are .009 and .007. Their absolute values are all less than .50. It also shows that the kurtosis values of female students' LA and LE are .136 and .114 respectively, and those of males are .163 and .159, all of which are less than 1. Therefore, the data is suitable for the independent sample *t*-test. The independent sample T test (see Table 5) reveals that there is significant difference between male and female students in LA and LE.

Females are more positive in LA than males, and females feel better in the overall LE. However, in the dimension of LE and environment males show better experiences than females. This dimension primarily concerns the use of various platforms in learning. Generally speaking, females may not be as skillful as males in the use of computer-mediated platforms. The operational difficulty for females has been increased by the existence of various platforms, and the experience of learning is therefore not as good as that of males.

TABLE 5
INDEPENDENT SAMPLE T-TEST RESULTS OF LA AND LE OF STUDENTS WITH DIFFERENT GENDER

	Gender	Cases	Average	SD		t	df	Significance
Learning attitude	Male	1793	4.4384	1.18725	AeV	-3.061	2700	.002*
	Female	909	4.5818	1.07393	AuV	-3.163	1993.935	.002*
Learning experience	Male	1793	4.7474	.74477	AeV	-3.114	2700	.002*
	Female	909	4.8415	.73553	AuV	-3.127	1844.707	.002*

* represents $P \leq .01$, indicating significant difference.

Key: AeV: assuming equal variance; AuV: assuming unequal variance

Grade Differences

Due to the number of courses they have taken and the distinct curriculum specifications, students in different grades show significant differences in their LA and LE. The LA of senior undergraduates, graduates and doctoral students are considerably more active, and their LE are also much better than those of junior undergraduates (Table 6). The reason may be that the courses in the first three years are various and intense, while there are typically no courses for senior undergraduates. Since graduates and doctoral students are supposed to conduct independent research, online teaching can give full play to such students.

TABLE 6
THE AVERAGE VALUES OF EACH DIMENSION OF STUDENTS IN DIFFERENT GRADES*

Grades		Learning attitude	Emotional dimension	Behavioral dimension	Cognitive dimension	Learning experience	Learning-related	Environment related
Freshmen	Average	4.2605	3.7636	4.3070	4.4269	4.6978	4.3018	5.4017
	Cases	691	691	691	691	691	691	691
Sophomores	Average	4.2806	3.8297	4.2740	4.4805	4.6754	4.3142	5.3177
	Cases	413	413	413	413	413	413	413
Juniors	Average	4.2448	3.7831	4.2604	4.4270	4.6258	4.2342	5.3219
	Cases	458	458	458	458	458	458	458
Seniors	Average	4.6307	4.2272	4.5236	4.9107	4.8452	4.6444	5.2021
	Cases	248	248	248	248	248	248	248
Graduates	Average	4.7582	4.3354	4.7098	4.9878	4.9146	4.7714	5.1691
	Cases	630	630	630	630	630	630	630
Doctoral students	Average	5.0411	4.6934	5.0087	5.2225	5.0362	4.9070	5.2659
	Cases	262	262	262	262	262	262	262
Total	Average	4.4866	4.0431	4.4759	4.6874	4.7791	4.4919	5.2896
	Cases	2702	2702	2702	2702	2702	2702	2702

*Note: The standard score is 4, and the average value higher than 4 means that the LA is more positive and the LE is better than the previous offline teaching.

Differences Between Schools

By comparing LA and experiences from different schools of SJTU in the questionnaire results, we found that students' overall LA and LE are better than the previous offline teaching (Table 7). Note that the schools with less than 10 cases were excluded. The LA of students in School A of science have been substantially improved compared to the previous offline teaching (Table 6). The students in the School H of engineering have the least improvement in both LA and LE, almost the same as the original results in offline teaching. Among all other schools, students in the School H of engineering achieved the highest score in the dimension of environment-related experience. This could be explained by the fact that the students and teachers in this school mostly major in computer-related disciplines, and thus they could take full advantage of various platforms. However, their scores are the lowest in terms of learning-related experience, and their overall scores for LE are thus not increased.

TABLE 7
THE AVERAGE VALUES OF EACH DIMENSION OF STUDENTS IN DIFFERENT COLLEGES*

Schools		Learning attitude	Emotional dimension	Behavioral dimension	Cognitive dimension	Learning experience	Learning-related	Environment related
School A of Science	Average	5.0112	4.7460	4.9150	5.2211	4.9095	4.7902	5.1217
	Cases	42	42	42	42	42	42	42
School A of Engineering	Average	4.8753	4.5399	4.8261	5.0683	5.0574	4.9246	5.2935
	Cases	92	92	92	92	92	92	92
School B of Engineering	Average	4.7641	4.3459	4.7505	4.9569	4.9211	4.7359	5.2504
	Cases	292	292	292	292	292	292	292
School C of Engineering	Average	4.7188	4.2968	4.7045	4.9139	4.7682	4.5608	5.1370
	Cases	73	73	73	73	73	73	73
Medical School A	Average	4.6761	4.2800	4.6629	4.8590	4.9872	4.8017	5.3170
	Cases	75	75	75	75	75	75	75
	Average	4.5841	4.1473	4.5482	4.8073	4.7949	4.5858	5.1667

School A of Arts	Cases	86	86	86	86	86	86	86
School B of Science	Average	4.5787	4.0571	4.6190	4.7619	4.8179	4.5554	5.2847
	Cases	105	105	105	105	105	105	105
School C of Science	Average	4.5238	4.1262	4.4350	4.7829	4.8188	4.5752	5.2517
	Cases	177	177	177	177	177	177	177
School D of Science	Average	4.5059	3.9889	4.5345	4.6988	4.7760	4.4708	5.3185
	Cases	120	120	120	120	120	120	120
School D of Engineering	Average	4.4830	4.1111	4.4954	4.6299	4.7380	4.4247	5.2950
	Cases	171	171	171	171	171	171	171
School B of Arts	Average	4.4598	3.9649	4.3904	4.7411	4.7614	4.4934	5.2377
	Cases	266	266	266	266	266	266	266
School E of Engineering	Average	4.4197	3.9353	4.4296	4.6173	4.7404	4.4363	5.2811
	Cases	268	268	268	268	268	268	268
School F of Engineering	Average	4.3741	3.8932	4.3645	4.5897	4.7415	4.4311	5.2934
	Cases	78	78	78	78	78	78	78
School G of Engineering	Average	4.3692	3.9552	4.3704	4.5454	4.7376	4.4108	5.3184
	Cases	565	565	565	565	565	565	565
School H of Engineering	Average	4.1174	3.5926	4.1529	4.3069	4.5647	4.0759	5.4337
	Cases	270	270	270	270	270	270	270
Total	Average	4.4866	4.0431	4.4759	4.6874	4.7791	4.4919	5.2896
	Cases	2702	2702	2702	2702	2702	2702	2702

*Note: The standard score is 4, and the average value higher than 4 means that the LA is more positive and the LE is better than the previous offline teaching.

Differences in the Availability of Independent Learning Space

Among the 2702 participants, 276 students have no independent learning space at home. The normal distribution test shows that the skewness values of LA and LE for students with independent learning space are .001 and .001 respectively, but those values of students without independent learning space are 0.96 and 0.77. The absolute values are all less than .50. It is also revealed that the kurtosis values of the students with independent learning space are .112 (LA) and .104 (LE), and those of the students without independent learning space are .101 and .426, all of which are less than 1. Therefore, the test demonstrates that the independent sample *t*-test is applicable to the data.

The lack of independent space significantly affects students' LA and LE. Their scores are significantly lower than those students with independent study space (Table 8). It shows that the learning environment has a major impact on the LA and LE of students.

TABLE 8
INDEPENDENT SAMPLE T-TEST RESULTS OF LEARNING ATTITUDE AND LE IN TERMS OF THE AVAILABILITY OF INDEPENDENT LEARNING SPACE

	Learning space	Number of cases	Average value	Standard deviation	t	Degree of freedom	Significance	
Learning attitude	Yes	2426	4.5673	1.11685	AeV	11.036	2700	.000*
	No	276	3.7771	1.21504	AuV	10.321	330.063	.000*
Learning experience	Yes	2426	4.8173	.73652	AeV	8.033	2700	.000*
	No	276	4.4426	.71427	AuV	8.232	344.982	.000*

* $p \leq .01$.

Key: AeV: assuming equal variance; AuV: assuming unequal variance; Learning space: means the availability of an independent space.

Differences in Presence of Parent Monitoring

The normal distribution test indicates that the skewness values of LA and LE for students with parental monitoring are .021 and .014 respectively, and those for students without parental monitoring are .060 and .074. The absolute values are all less than .50. It is also found that the kurtosis values of the student with monitoring are .252 (LA) and .402 (LE), and those of the students without monitoring are .319 and .457. They are all less than 1. Therefore, the test substantiates that the independent sample *t*-test is suitable.

The results show that some students lack self-regulated learning abilities without parents' monitoring. The monitoring from parents during online learning has become an important factor that influences the LA and LE of students. Data analysis (Table 9) shows that students with parents' monitoring are considerably better than others in LA and LE.

TABLE 9
INDEPENDENT SAMPLE T-TEST RESULTS OF LA AND LE IN TERMS OF PARENTS' MONITORING

	Parents' restraints	Number of cases	Average value	SD		t	df	Significance
Learning attitude	Yes	905	4.7824	1.11472	AeV	9.629	2700	.000*
	No	1797	4.3377	1.14223	AuV	9.707	1852.143	.000*
Learning experience	Yes	905	4.9278	.76838	AeV	7.460	2700	.000*
	No	1797	4.7042	.71833	AuV	7.296	1708.333	.000*

* $p \leq .01$.

Key: AeV: assuming equal variance; AuV: assuming unequal variance

DISCUSSION

The results have demonstrated that students' LA and LE in real-time online teaching are determined by such factors as the information transmission characteristics, the design of online teaching, the usability of online teaching platform, the availability of independent learning space, the self-regulated learning abilities, and the learning styles of the students. To improve the LA and LE of students in online teaching, the following may be foregrounded:

- 1) Using a multitude of interactive ways to increase the engagement of students in class will effectively enhance the LA and LE of students. It is essential for teachers to embrace a variety of interactive methods and strategies in order to retain students' attention at a high level. The interactive teaching methods and strategies during the class are therefore much needed. For example, teachers can adopt the bookshelf strategies, such as questioning, practice, development, demonstration, hands-on activities and animation (Gibbs & Habeshaw, 1992). Long-term monotonous stimulation reduces the effectiveness of concentration, but individuals' attention can be aroused via fresh stimulations (Sternberg & Sternberg, 2011).
- 2) The collaborative work in online learning environment is less productive, which has a considerable impact on the students' LA and LE. The learning effect is closely linked to the learning environment. 46.6% of the participants say that the family environment is not suitable for learning. Particularly for those students with field-dependent learning styles, they give priority to social relationships and have strong reliance on external reference (Wo et al., 2004). Similarly, in online learning such as MOOCs those who can persist are the students with strong intrinsic motivation (Belanger & Thornton, 2013). In this sense, offline learning is not merely a matter of switching the knowledge transfer medium, but provides students with an enjoyable and appropriate learning environment.
- 3) A fully operational platform cannot only improve the LE of students, but also ensure the quality of online teaching. Variety in platforms and preferences increases the workload of students.

This will inevitably influence the LE and learning effectiveness of students. Thus, universities should upgrade the curriculum platforms and provide more technical support to students and teachers. With the results we found, it is reasonable to say that if all the functions can be integrated into one platform, and an independent learning space is available at home, the LE will be significantly improved.

- 4) To improve the quality of teaching, the commitment of colleges and teachers in teaching is vitally important. High-quality teaching will naturally yield positive LA and LE. Under the same condition of online teaching, however, the average score of LA and LE of students from School A of science is higher than that of School H of engineering. The differences may be due to different natures of disciplines and the commitment of colleges.
- 5) Cultivating students' independent learning abilities can effectively improve students' LA and LE as well as the overall learning effects both in online and offline teachings. Real-time online teaching has brought significant challenges to students' self-regulated learning abilities. In this process, students with strong self-regulated learning abilities can perform better than students with weak self-regulated learning abilities. Students with parents' monitoring have significantly higher scores of LA and LE than those who lack it. Self-regulated learning ability is the ability to establish learning goals, make learning plans, select learning methods, use learning resources, track learning process and assess learning outcomes on the basis of their evaluation of the task requirements and their own knowledge and skills (Butler & Winne, 1995). Whether it is in online teaching or offline teaching, self-regulated learning ability directly influences students' learning achievements.
- 6) Online and offline teaching complement each other, and the mixed teaching can significantly improve students' LA and LE. With the spread of large-scale real-time online teaching during the pandemic, teachers and students recognize the advantages and disadvantages of online teaching. Functionalities, such as the ease of accessibility of teaching materials and the review function of online teaching, have significantly improved the learning effectiveness of students. The emotional aspect, however, is also much needed. Since one of the trends of higher education in the future is the broad implementation of the mixed teaching design (Johnson et al. 2016), the factors need to be further studied.

CONCLUSION

To sum up, LA and LE of university students in real-time online learning have been both helpful and problematic. Significant differences have been found in gender, the availability of independent learning space, the parents' monitoring, discipline and grade. Some of the LA and LE have helped improve the learning itself. Yet, online teaching has increased students' academic workload and brought great challenges to students' attention, self-regulated learning abilities, as well as physical and mental health. Many issues still remain.

The limitation of the study is apparent: it is a case study only. It is necessary to extend the research to other universities across the country, and to universities from other countries. Secondly, the real-time online teaching has also applied to primary and secondary schools during the pandemic, but this was not included. Students' self-regulated learning abilities, learning motivations and learning materials in primary and secondary school are completely different and their online LA and LE are worthy of further discussion.

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ENDNOTE

- ^{1.} It represents the qualitative feedback of the respondent No. 342, and this principle applies to others. If a respondent provided multiple qualitative feedback, only the most heterogeneous feedback was selected.

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