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French Horn Students' Performance Improvement and Perceptions of Learning through Synchronous Virtual Classroom: An Empirical Research at Hunan Normal University

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Abstract

Synchronous virtual classroom has been widely used by universities as an alternative teaching method under the covid-19 pandemic, however, in the world of French horn education, there is a lack of scholarly attention on discovering how synchronous virtual classroom could affect students' performance improvement and perceptions. The purpose of this study is to use a synchronous virtual classroom course to assess the sample participants' performance improvement and perceptions; and then to analyze and evaluate the results from the assessment. This study used a paired sample t-test analysis to investigate whether this learning approach has caused significant improvement on students' performances; and used a questionnaire analysis and a template analysis based on data collected from interviews to investigate how the students think about the course, and to explore the potential benefits and drawbacks that this learning approach has. The main research findings of this study indicate that, in terms of performance improvements, synchronous virtual classroom significantly improved French horn students' overall performance improvement; in terms of students' perceptions, such a learning method is mentally acceptable by the students, in which they were generally satisfied with this learning approach.

Keywords: Synchronous virtual classroom, French horn, Education

JEL Classification Code: I23, P36

1. Introduction

Besides the modern digital technology development which has largely contributed to today's growth of online education, the ongoing covid-19 pandemic has also been a catalyst for online learning to be commonly accepted as a solution to maintain education (Rizvi & Nabi, 2021). Due to the contagious nature of the COVID-19 pandemic, the use of online learning has become visibly extensive more than ever, as it ensures both teachers' and students' health and safety while delivering education during the pandemic (Shahriar et al., 2021). Synchronous virtual classroom is an applicable method to achieve online learning, it is defined as the instructor-led synchronous computer environment attended by participants online at the same time but in different locations, it is identified as an effective learning model, offering students a virtual setting in which they could raise and discuss

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questions in oral or forms of communication in real-time (Stewart et al., 2011).

In the field of instrumental music education, the use of synchronous virtual classroom has become more and more popular, however, the voices regarding its influences in terms of music students' performances and their perceptions of learning are varied. Shoemaker and van Stam (2010) conducted a study to examine the students' performance improvement of learning e-piano lessons through different online learning approaches. Their study argued that once the instructor and the participants are familiar with the online virtual learning environment, the use of video-conference technology through online applications or platforms with a stable network connection should allow the virtual classroom to be mostly alike to the face-to-face classroom and result in similar learning progress and deliver a similar level of performance improvement (Shoemaker & van Stam, 2010). On the other hand, in an exploratory study on using videoconferencing for trumpet lessons conducted by Dammers (2009), it was argued that the use of videoconference can only be functional, but not equivalent to the traditional face-to-face classroom, thereby does not result in a similar level of performance improvement. Dammers (2009) identified that interruption due to loss of internet connection, lower quality of sound and visual due to the video transmission, and weaken interpersonal connection are the 3 main negative influential factors that make synchronous virtual classroom not producing significant improvement on students' trumpet performance, and thereby not suitable to be used as a primary learning model.

At Hunan Normal University, face-to-face teaching and learning have been the primary method for French horn teachers and students. Ever since the Covid-19 pandemic, the synchronous virtual classroom was adapted by many teachers and students from time to time, due to precaution concerns or school lockdowns (HNU, 2020a). With today's emerging technologies and the unstable educational environment due to the Covid-19 pandemic, the teaching and learning of many subjects, including French horn, is facing an increasing use of the virtual classroom to facilitate study. However, as Irene et al. (2021) mentioned, incorporating technology into the learning process does not necessarily facilitate students' learning. Thus, for modern French horn education, it is necessary to assess and evaluate the student's performance improvement and their perceptions of learning French horn through synchronous virtual classroom, to enhance the quality of such learning approach and the quality of students' learning. Relevant literature regarding the French horn mainly focuses on in-class pedagogy (Hill, 2001; Martin, 2020), resulting in a lack of research on contemporary French horn teaching and learning development. This study aims to fill this void by providing a thorough literature review on the modern French horn teaching and learning, then to conduct detailed empirical research on the performance improvement and students' perceptions of learning horn through the synchronous virtual classroom, to answer the following research questions:

1. How should the synchronous virtual classroom be constructed for French horn students at Hunan Normal University?

2. What does the result show regarding students' performance improvement and perceptions of learning through the French horn synchronous virtual classroom?

The corresponding research objectives are listed as below:

1. To develop a synchronous virtual classroom lesson plan for French horn students at Hunan Normal University.

2. To assess and deliver an evaluation of results on students' performance improvement and perceptions through the French horn synchronous virtual classroom.

2. Literature Review

2.1 Review of French horn education

The French horn is a circular valved brass instrument that is indispensable for an orchestra and has countless audiences in the world. Nowadays, the French horn performance courses in universities around the world, are still being taught mainly in a traditional face-to-face learning environment, where instructors show the students how to play the French horn by playing in front of them and having discussions in the physical classroom (Jenkins, 2016). However, since the global outbreak of COVID-19, the World Health Organization (WHO) has implemented many precautionary efforts towards containing the viral spreading, forcing various educational institutions around the world to adapt distance learning (Karasneh et al., 2021), resulting in an increasing use of synchronous virtual classroom. Although by researching public course information available on their websites, there are hardly any universities that put virtual classroom learning model in their French Horn curriculum, many have been forced to adapt such model in real life due to the pandemic situation. Hochschule für Musik Hanns Eisler Berlin (HMHEB), a world-famous music university located in Germany, officially set its 20/21 winter semester as a "Hybrid semester", which means online teaching and learning through virtual classroom were required to be adapted frequently and flexibly according to the current situation. Such regulation is set for students in all majors including French horn according to its website (HMHEB, 2022). Hochschule für Musik und Theater München (HMTM), another top German music university, also changes its regulations according to the pandemic situation. In its regulations posted in 2021, it re-allowed face-to-face courses to be held but still required that lectures and any courses that have many participants to be taken place online (HMTM, 2021).

In China, French horn educational development has been relatively slow for many reasons, for example, the French horn had been not as popular as some of the other instruments because of its high cost of learning, and the atmosphere of learning western instruments in the past was generally low (He, 2018). Despite these obstacles, such development has begun to accelerate in recent years as more Chinese students now have the willingness and financial

ability to learn French horn. Now, French horn has become indispensable in many music higher education institutes in China as the French horn performance major appears in many universities' enrollment guides. Although the face-to-face classroom is still being primarily used by Chinese music institutions to teach French horn, similar to other universities around the world that were affected by the Covid virus, universities in China had to adapt online virtual classroom as one of the approaches to comply with the "Stop face-to-face classroom, but not stop learning" measure regulated by the Ministry of Education of China.

Before the pandemic, French horn teaching and learning in HNU mainly takes place in the form of face-to-face lessons. Although teachers and students share their horn performance videos from time to time, this kind of online learning stayed in an asynchronous model in which they used video recordings instead of having lessons through live virtual classrooms. This situation has changed dramatically since the covid-19 outbreak in China, as instrument performance-related majors including French horn have been required to be held online via a suitable online platform (e.g., Dingtalk) that can enable virtual class online learning (HNU, 2020a). Thus, French horn learning at HNU was moved from face-to-face to virtual during the required period followed by the university's instruction. Despite students in HNU returned to the face-to-face classroom since September 2020 as the pandemic situation became stable in China, an in-school survey has shown that most of the teachers from the music college of HNU recognized the benefit of virtual classroom and are willing to continue using such approach in the future (HNU, 2020b).

Playing posture

Correct playing posture is important to comfortably producing a good tone on the horn. While playing, the player's back and neck must always be in line. The most important thing to remember is that the posture must be as upright as possible without causing any excess tension; the entire body must be as relaxed as possible to avoid tension creeping into the sound (Farkas, 1999). Students' scores in this criterion will be given based on how well horn players hold their horns and how well they stand or sit.

Integrity of music

In the assessment standard of this study, integrity of music means the quality of completion of the music piece performed. Students should play the music completely without disconnection or interruption. Students' score in this criterion will be given based on whether the horn player has problems of discontinuity during the performance (Farkas, 1999).

Rhythm

Students should play according to the speed of the music piece, and the rhythm should be stable, not fast, or slow. Students' score in this criterion will be given based on how their rhythm fits the music pieces they perform and how steady the rhythm is (Foulk, 2017).

Intonation

Students should pay attention to the quality of intonation when playing, and each tone should be controlled within the accurate intonation range. Students' score in this criterion will be given based on the student's control of intonation, whether there is a large deviation in intonation (Farkas, 1999).

Breath control

The control of the breath is essential for a French horn player as it directly determines whether the horn can be blown and can be blown well. It requires techniques such as grabbing as much air as possible in the shortest time possible, without changing your embouchure (Farkas, 1999). Students' scores in this criterion will be given based on how well the students control their breath and produce the sound.

Fluency

Horn students should play the music piece clearly and smoothly without mistakes in terms of horn skills. Students' scores in this criterion will be given based on how smoothly they can play the music piece (Foulk, 2017).

Performance skills

Students need to play the music through the playing skills such as phonation and articulation. Students' scores in this criterion will be given based on how well they have mastered these horn performing techniques (Farkas, 1999).

Mastery of music style

Music pieces were created by different composers at different times, and every composer has his/her own unique musical style. Students should perform the music by learning about each composer's style, the story background of the piece, and so on. Students' scores in this criterion will be given based on the students' knowledge of the piece and their understanding of the musical style of the piece (Foulk, 2017).

Mouth shape

Students should play the horn with the correct mouth shape. The mouth shape is the most basic and important element of playing the horn. A good mouth shape will help the horn player to produce a good sound, thereby deliver a better performance. Students' scores in this criterion will be given based on whether horn players have mastered the correct shape of their mouths (Foulk, 2017).

Emotions

French horn students should express their emotions suitably through their own understanding of the music when playing. Students' scores in this criterion will be given based on how well their emotions fit into the music while playing (Farkas, 1999).

2.2 Conceptual Framework

Figure 1 is the conceptual framework for this research. This research uses a mixed research method which involves both quantitative and qualitative research methods. To test the two dependent variables, students' performances, and perceptions. An 8-week synchronous virtual classroom course was designed and put into practice with sample participants in this study, thereby making the sample participants' status of learning the course the independent variables (before and after the course). Pre-tests and post-tests on sample students' performances were conducted before and after the 8-week course, and the obtained scores were used to analyze the students' improvement in not only their overall performances but also their performances in 10 specific criteria (Playing posture, Integrity of music, Rhythm, Intonation, Breath control, Fluency, Performance skill, Mastery of music style, Mouth shape, and Emotions). As for assessing the sample participants' perceptions, a questionnaire and an in-depth semi-structured interview was performed with the participants individually after the post-test. The questionnaire was used to collect quantitative data whereas the interview was used to collect the qualitative data from the sample participants.

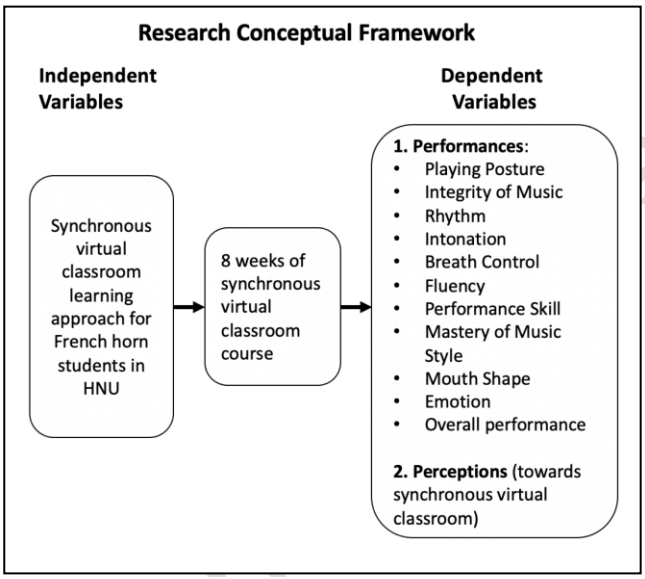

Figure 1. The Conceptual Framework

2.3 Hypotheses

In the process of assessing students' performances, statistical tests were conducted to examine 11 hypotheses in performance improvement (shown in table 1) and produce hypotheses testing results.

Table 1: List of Hypotheses in the Study

Hypotheses	Statement
H1	There is a significant difference between the French horn students' scores in Playing Posture before and after the synchronous virtual classroom course.
H2	There is a significant difference between the French horn students' scores in Integrity of Music before and after the synchronous virtual classroom course.
H3	There is a significant difference between the French horn students' scores in Rhythm before and after the synchronous virtual classroom course.
H4	There is a significant difference between the French horn students' scores in Intonation before and after the synchronous virtual classroom course.
H5	There is a significant difference between the French horn students' scores in Breath Control before and after the synchronous virtual classroom course.
H6	There is a significant difference between the French horn students' scores in Fluency before and after the synchronous virtual classroom course.
H7	There is a significant difference between the French horn students' scores in Performance Skill before and after the synchronous virtual classroom course.
H8	There is a significant difference between the French horn students' scores in Mastery of Music Style before and after the synchronous virtual classroom course.
H9	There is a significant difference between the French horn students' scores in Mouth Shape before and after the synchronous virtual classroom course.
H10	There is a significant difference between the French horn students' scores in Emotion before and after the synchronous virtual classroom course.
H11	There is a significant difference between the French horn students' scores in Overall Performance before and after the synchronous virtual classroom course.

3. Methodology

3.1 Lesson Plan Design

To conduct experiments for assessing the French horn students' performance improvement and their perceptions of the virtual classroom, a virtual classroom lesson plan is needed for the experiment to proceed. Designing a virtual classroom lesson plan is also the second objective of this research. The first step of forming the lesson plan is to select a suitable platform to construct the virtual classroom, and in this study, DingTalk is chosen. DingTalk is a leading intelligent mobile office platform (app) in China, which allows more than 300 users to access an online live video meeting synchronously via using electronic devices, its live-video communication function makes it became one of the most used platforms for online learning, and it is also widely used as a reliable solution for students who cannot participate in the face-to-face classroom due to school lockdowns or precautions during the covid-19 pandemic in China (Li, 2020). In China, DingTalk has been used as a tool that enables online virtual classroom ever since the beginning stage of the Covid-19 pandemic.

The next step is to design the lesson plan for the experiment. The virtual classroom lessons were set as 8 weeks, each participant had 1 lesson per week and each lesson is 1 hour long. Within the 8 lessons for each participant, only 7 lessons are one-to-one lessons, and 1 lesson is designed in a group model, in which all the participants have a joint virtual lesson together at the same time. So that every participant had 8 virtual classroom lessons in total. The main teaching content of the lessons were designed for the purpose of improving students' certain abilities that were later assessed during the performance tests according to the assessment standard. In addition, the lesson plan was also designed with the intention to minimize the known potential issues learned from related experiments, for example, by asking students to be extra aware of their internet connection before every lesson starts, making sure that the devices used to conduct the lesson are well-functioned to ensure the quality of video transmission, etc. The detailed lesson plan is illustrated in the table 2 below. DingTalk was used as the platform for the course, students are required to have the DingTalk app downloaded on their phones or their laptops and logged in successfully before each lesson. Moreover, the course content were similar to their current curriculum and will be aiming at improving their horn performance from the 10 assessment criteria.

Table 2: Detailed Synchronous Virtual Classroom Lesson Plan

Study hours	Weeks of study in total	Hour of study per week per student	Assessment method	Main learning content
8	8	1	Face-to-face live performance and assessed by 3 professional experts	The repertories and performance pieces in the exam
Number of lessons	Location	Type of class	Learning content	Abilities need to be improved
1	Online (Dingtalk)	1 to 1	Make sure the electronic devices at both students and teacher's ends are well-functioned and recheck the internet connection (mandatory in each lesson). Give tutorial on how to use Dingtalk to access virtual classroom before the first lesson. Start the course with basic practices, train the students on their quality of playing the scales, deepen their understanding regarding long tone technique.	Playing Posture Breath Control Mouth Shape
2	Online (Dingtalk)	1 to 1	Teach the students on their performance of etude, correct their various mistakes made during their performance. Getting them ready to learn repertoire.	Performance Skill Rhythm Intonation
3	Online (Dingtalk)	1 to 1	Learn the repertoire, get familiar with pitch, pay attention to basic practice such as controlling mouth shape, breath practice, etc.	Breath Control Mouth Shape Performance Skill Integrity of Music
4	Online (Dingtalk)	1 to 1	Check the homework from last lesson, breath exercises, practice the etudes with appropriate speed and with acceleration.	Integrity of Music Rhythm Intonation
5	Online (Dingtalk)	1 to 1	Review the last assignment, consolidate the etude practice, assign a simple piece	Performance Skill Fluency Mastery of Music Style
6	Online (Dingtalk)	1 to 1	Review the skills learned during the previous lessons, master the etude practice, assign a simple piece to the students to practice their performance skills.	Performance Skill Fluency Mastery of Music Style Emotions
7	Online (Dingtalk)	1 to 1	Let the students perform, focus on adjusting the details and emotional processing of music, making the students	Integrity of Music Mastery of Music Style

Study hours	Weeks of study in total	Hour of study per week per student	Assessment method	Main learning content
			master the scale, etude, and repertoire.	Emotions
8	Online (Dingtalk)	Group class	Host the group synchronous virtual classroom, focus on demonstration, and try to enhance the students' understanding from watching the teacher perform.	General ability covers all specific aspects mentioned above.

3.2 Population and Sample

In total, there are currently 29 French horn students studying at the HNU, therefore 29 is the population of this study. The sampling method used in this study is voluntary sampling. Voluntary sampling is defined as a type of convenience sampling, where the decision to participate strongly relies on respondents due to the non-individualized nature of invitations (Wolf et al., 2016). In this study, all French horn students in HNU were asked about the French horn synchronous virtual classroom experiment, and 12 students responded with willingness of participation. Thus, the 12 students with willingness of participation were selected as the sample participants of the experiment of the study. Despite the sample size is small, as argued by (Malterud et al., 2016), such a small sample is still sufficient as if the aim of the research is narrow and well-focused, and the researcher possesses relevant professional expertise in the specific field of study.

3.3 Performance Tests (Assessing Performance Improvement)

In this research, sample students' performances were shown in a quantitative way, which they were measured in terms of scores based on the assessment standard from the HNU (table 3), and students' improvement in both individual criteria and overall performance were indicated as the difference between the scores before and after having experienced the synchronous virtual classroom lessons, then assessed through a paired-sample t-test. According to the standard, students' horn performances were assessed from 10 specific criteria: Playing posture, Integrity of music, Rhythm, Intonation, Breath control, Fluency, Performance skill, Mastery of music style, Mouth shape, and Emotions. The maximum of each criterion is 10 points, and they construct the total score of 100 points for overall performance. The test was carried out individually on a face-to-face basis. Scores were calculated as the average number of the scores given by the 3 French horn experts regarding the 10 individual criteria from the assessment standard.

Table 3: HNU French Horn Performance Assessment Standard

HNU French Horn Performance Assessment Standard											
Specific Criteria	**Playing Posture**	**Integrity of Music**	**Rhythm**	**Intonation**	**Breath Control**	**Fluency**	**Performance Skill**	**Mastery of Music Style**	**Mouth Shape**	**Emotion**	**Total Score**
Score	10	10	10	10	10	10	10	10	10	10	100

Moreover, paired sample t-test is used to test the hypotheses. Paired sample t-test is an appropriate data analysis method for the experiment in this study as the measurements are taken from the same group of students at two different times. If the difference between pre-and post-test of a criterion is significant, then by comparing the mean difference, it can be observed whether such a significant difference is an improvement (significant increase) or a setback (significant decrease) in terms of scores.

3.4 Questionnaire and Interview (Assessing Perceptions)

To assess the students' perceptions of the quality of their learning approach (synchronous virtual classroom), a questionnaire and an in-depth interview were conducted to collect both quantitative and qualitative data regarding students' perceptions. The questionnaire consists of 16 question items, aims to measure each participant's perceptions on several pre-determined questions regarding the quality of the synchronous virtual classroom learning approach (see table 4); whereas the in-depth interview aims to discover how each student evaluates their experiences in such a learning approach, to bring their thoughts to an open discussion and to obtain a deeper understanding on their perceptions. All 12 sample participants were be asked to complete the questionnaire after the 8-week course, then attend the interview on a one-to-one basis.

Table 4: Survey Question Items

Section	Item	Question	Sources
Learning effectiveness	Q1	The instructor helped to keep course participants engaged and participating in productive dialogue.	(Swan et al., 2008)
	Q2	I felt comfortable interacting with other course participants.	(Swan et al., 2008)
	Q3	Discussions over the learning materials in the virtual classroom were valuable to me.	(Swan et al., 2008)
	Q4	Learning French horn online through synchronous virtual classroom is an effective learning style.	(Swan et al., 2008)
Student satisfaction	Q5	I am satisfied with my overall experience in this course.	(Gray & DiLoreto, 2016)
	Q6	The information provided during the course and the layout of the course are clear and useful to me.	(Gray & DiLoreto, 2016)
	Q7	I would recommend this course to other students.	(Gray & DiLoreto, 2016)
	Q8	I would like to keep using this learning approach in my future study.	(Gray & DiLoreto, 2016)
Scale	Q9	The functions on the platform I used in this course, did not incur any unreasonable cost.	(Bourne & Moore, 2004)
	Q10	The learning materials used in during the course is open resources, which I can access freely.	(Bourne & Moore, 2004)
	Q11	Online learning enables me to decide on the best time to learn.	(Wei & Chou, 2020)
	Q12	Learning through synchronous virtual classroom overcomes the constrains from time and location.	(Wei & Chou, 2020)
Access	Q13	I am satisfied with the manner in which guidelines of accessing the virtual classroom were clearly provided and taught by the instructor.	(Frey et al., 2003)
	Q14	The online platform used in the course is easily accessible to the student and easy to use, meets the needs of diverse learners.	(Frey et al., 2003)
	Q15	Technical assistance is timely provided by the instructor during the synchronous virtual classroom course, helped in completing the course successfully	(Frey et al., 2003)
	Q16	I am supported throughout the course when using the synchronous virtual classroom online platform as my learning approach.	(Frey et al., 2003)

To provide a comprehensive view of the participants' perceptions on the quality of their synchronous virtual classroom learning, The OLC Framework (Online Learning Consortium), which has been used as the underlying framework by numerous educational institutions to ensure the quality of their online teaching programs (Gurley, 2018; Muller et al., 2020) is used in this study to set the themes of the questionnaire and interview questions. OLC has identified "learning effectiveness", "student satisfaction", "faculty satisfaction", "scale" (cost-effectiveness), and "access" as the five pillars for achieving quality in online education (Muller et al., 2020). A decent online learning approach needs to show positive outcomes in each of the 5 pillars, and more importantly, the students' thoughts on these pillars can reflect their perceptions of the overall quality of a particular online learning approach (Bowman, 2014). In this study, only 4 out of 5 pillars are referred to and considered, the pillar "faculty satisfaction" is excluded as it solely relates to teachers and educational institutions whereas this study aims to investigate perceptions from the student side, not the teacher or institution side. Thus, previous questionnaire instruments from literature related to the 4 pillars were referred to when constructing the questionnaire and interview instruments. Moreover, the questionnaire of this study is designed in a Likert scale format (Likert, 1932), where participants have quantifiable options for each question (Strongly agree=5, Agree=4, Normal=3, Disagree=2, Strongly disagree=1). In addition, the questionnaires were sent out to the participants after the 8-week course and collected anonymously.

All the sample participants were required to have a semi-structured interview after completing the questionnaire. The interview was conducted in Chinese, and the duration was around 20 minutes. In the semi-structured interview, the planned interview questions are also divided into 4 themes (Learning Effectiveness, Student Satisfaction, Scale, and Access). Besides the main questions and the planned follow-up questions in the interview guide, the interviewer can go deeper and ask unplanned follow-up questions (questions that arise during the interview based on participant responses) (DeJonckheere & Vaughn, 2019). The semi-structured face-to-face interviews were recorded, and the qualitative data were collected in the form of interview transcripts. After collecting the data, template analysis was used as the method to code the interview transcripts. Template analysis is identified as a specific type of thematic analysis that emphasizes the use of hierarchical coding and is often used to analyze qualitative data (King, 2004). Nvivo, the qualitative data analysis computer software, is used to obtain codes in the coding process of this study. Overall, the basic process of assessing horn students' perceptions via interview in this study is:

1. to conduct face-to-face semi-structured interviews,
2. to record and form the interview transcript,
3. to code the transcript, form the final template,
4. to analyze the final template and to evaluate students' perceptions of learning.

In addition, the validity of the questionnaire items and

planned interview questions were ensured by using the Item Objective Congruence (IOC) Index in which the validity scores were given by 3 French horn experts from Chinese universities and orchestras (see Table 5). The reliability of the question items was examined by calculating Cronbach's alpha from the results of a pilot test, where 5 undergraduate students in music instrument performance major who had previous courses in the synchronous virtual classroom model are invited to complete the questionnaire. All question items in this study were tested to be acceptable as their Cronbach's alphas were greater than 0.7 (George & Mallery, 2006).

Table 5: Questionnaire and Interview Question Items Validation

Questionnaire Item Validation							
Topic	**Item Number**	**Score from the 3 Experts**			**Total Score**	**IOC Index**	**Result**
Learning effectiveness	Q1	1	1	1	3	1	Pass
	Q2	1	1	1	3	1	Pass
	Q3	0	1	1	2	0.67	Pass
	Q4	1	1	1	3	1	Pass
Student satisfaction	Q5	1	1	1	3	1	Pass
	Q6	1	1	1	3	1	Pass
	Q7	1	1	1	3	1	Pass
	Q8	1	1	1	3	1	Pass
Scale	Q9	1	1	1	3	1	Pass
	Q10	1	1	1	3	1	Pass
	Q11	1	0	1	2	0.67	Pass
	Q12	1	1	1	3	1	Pass
Access	Q13	1	1	1	3	1	Pass
	Q14	1	1	1	3	1	Pass
	Q15	1	1	1	3	1	Pass
	Q16	1	1	1	3	1	Pass
Interview Item Validation							
Topic	Item Number	Score from the 3 Experts			Total Score	IOC Index	Result
Learning effectiveness	1	1	1	1	3	1	Pass
	1(follow-up)	1	1	1	3	1	Pass
	2	1	1	1	3	1	Pass
	2(follow-up)	1	1	1	3	1	Pass
	3	1	1	1	3	1	Pass
	3(follow-up)	1	1	1	3	1	Pass
	4	1	1	1	3	1	Pass
Student satisfaction	5	1	1	1	3	1	Pass
	6	1	0	1	2	0.67	Pass
	7	1	1	1	3	1	Pass
Scale	8	1	1	1	3	1	Pass
	9	1	1	1	3	1	Pass
Access	10	0	1	1	2	0.67	Pass
	11	1	1	1	3	1	Pass
	11(follow-up)	1	1	1	3	1	Pass

4. Data analysis and results

4.1 Analysis and Results on Performance Improvement

By using SPSS to conduct the paired sample t-tests, p-values were obtained and used to examine the significance of the performance improvement. The table 6 below shows the overall results on students' performance in each criterion specified in the performance standard of HNU and their overall performance. For the specific criteria, students in 4 out of 10 did not show significant improvements, they are Playing Posture, Intonation, Breath Control, and Mouth Shape. Students showed statistically significant performance improvement in the other 6 specific criteria (Integrity of Music, Rhythm, Fluency, Performance Skill, Mastery of Music Style, and Emotions) and their overall performance. Among the 6 specific criteria which have been significantly improved, integrity of music has been improved the most with the average score increased by 1.50

points. For Fluency, Rhythm, Performance skill and Mastery of music style, the students' average performance has been improved by equal or more than 1 point. The average score improved for Emotion is the lowest among these 6 criteria, which is 0.67 points. As for the students' total performance, their total scores have improved by 7.08 points on average, which is a considerable significant improvement in terms of students' overall performance.

Table 6: Hypotheses Test Results

Criterion	Hypothesis		Result	Mean Score Difference (Post-test – Pre-test)	Standard Deviation	T-value	Degree of Freedom	P-value
Playing Posture	H1	Rejected	Not significantly improved	0.17	0.577	-1.000	11	0.339
Integrity of Music	H2	Supported	Significantly improved	1.50	0.905	-5.745	11	0.000
Rhythm	H3	Supported	Significantly improved	1.08	0.900	-4.618	11	0.002
Intonation	H4	Rejected	Not significantly improved	0.33	0.985	-1.173	11	0.266
Breath Control	H5	Rejected	Not significantly improved	0.08	0.669	-0.432	11	0.674
Fluency	H6	Supported	Significantly improved	1,33	0.779	-5.933	11	0.000
Performance Skill	H7	Supported	Significantly improved	1.00	0.603	-5.745	11	0.000
Mastery of Music style	H8	Supported	Significantly improved	1.00	0.853	-4.062	11	0.002
Mouth Shape	H9	Rejected	Not significantly improved	-0.08	0.669	0.432	11	0.674
Emotions	H10	Supported	Significantly improved	0.67	0.888	-2.602	11	0.025
Overall Performance	H11	Supported	Significantly improved	7.08	2.644	-9.279	11	0.000

4.2 Analysis and Results on Perceptions

As for results on perceptions, the questionnaire results show a generally positive response from the students. For the 4 sections of the questionnaire, "Access" shows the highest support rate, as all answers are "Strongly agree" or "Agree". Section "Scale" has the second highest percentage of answers selecting "Strongly agree" (70.8%). As for the section "Student satisfaction", 95.8% of the answers in questions from this section are "Strongly agree" or "Agree", and 4.2% of the answers are "Neutral". "Learning effectiveness" has the lowest support rate with only 77.1% of the answers being "Strongly agree" or "Agree", and it is the only section that has participants selecting "Disagree" (8.3%). These results show that the participants have the most positive perceptions on the quality of the course in terms of its "Access", and "Learning effectiveness", though still having a decent rate of positive answers, this rate is the lowest among the 4 sections.

As for the interview analysis, after coding the participants' transcripts, all the codes were revised and organized to form the final templates. The final temple illustrated in this study is the comprehensive version of the 12 students' answers. A new theme and many lower-order codes emerged in the final template. Within the final template, many positive codes stand for positive student perceptions, and several negative codes stand for negative student perceptions. Several major advantages that the students think a synchronous virtual classroom could offer compared to the traditional face-to-face classroom are: firstly, the pace of the class is slower which makes them easy to follow; secondly, the communication between teacher and students is clear; thirdly, the pause and re-start happens less than before when they are asked to play during the lesson and the lesson goes more fluently; fourthly, it saves their time and money from travel, and thereby has more time to practice and prepare for the class. On the other hand, students also pointed out some of the disadvantages and limitations of the synchronous virtual classroom. For example, the interaction among the students is minimized during the group class; their senses are being limited by the virtual environment, such as they cannot feel the full emotion of music when hearing it through their phones or laptops; this learning method has high requirements for the network condition, and the network condition largely affects the quality of their learning; they have worries in the sound and video transmission quality, some students think that to hear them play in real life could end up either having the higher quality or having more potential mistakes than to hear from an electronic device, and the teacher could have

noticedmore of their improvements and mistakes a real-life environment. Nevertheless, from the students' perspectives, the advantages of learning through synchronous virtual classroom outweigh its disadvantages as there are a lot more positive codes than negative code

Table 7: Final Template of Interview Analysis

Final template	
1.	**Perceptions on learning effectiveness**
1.1	Perceptions on student-instructor interaction
1.1.1	Clear communication
1.1.1.1	Paying more attention on conversation
1.1.1.2	Specific explanation from teacher
1.1.1.3	Enhanced understanding
1.1.1.4	Careful wording
1.1.2	Fluent tempo of class
1.1.2.1	Less pauses while playing
1.1.2.2	Concentrated comments
1.1.3	Slower pace of class
1.1.3.1	Slow speed of talking
1.1.3.2	Given more time to think before re-start
1.2	Perceptions on student-student interaction
1.2.1	Limited interaction with classmate
1.2.1.1	Unable to have conversation with specific classmate
1.2.1.2	Instructor-led interaction
1.2.1.3	No interaction with classmates in 1-to-1 lessons
1.2.2	Single performer only
1.2.2.1	Cannot practice duet or in group with classmates
1.2.2.2	Cannot play with teacher together
1.3	Perceptions on student-content interaction
1.3.1	Get more prepared
1.3.1.1	Pre-read course material before class
1.3.1.2	Supervision from parents
2.	**Student satisfaction**
2.1	General satisfaction
2.1.1	Generally satisfied
2.1.2	Valuable alternative
2.1.3	Combination with face-to-face model
2.1.4	Limited learning environment
2.1.4.1	No physical instruction
2.1.4.2	Less emotional affection
2.1.4.3	Not actual live performance
2.2	Perceptions on the course information and course lay out
2.2.1	Familiar and appropriate
2.2.1.1	Well-structured lesson
2.2.1.2	Structure similar to face-to-face model
2.2.1.3	Preparation material sent before lesson
2.3	Willingness of continuance or recommendation
2.3.1	Recommend to other students
2.3.1.1	Different potential influence on different students
2.3.1.2	Interesting learning experience
2.3.1.3	During covid virus precaution period or lock-down
2.3.2	Continue this study model
2.3.2.1	Improved performance skills
2.3.2.2	Helping with exam and graduation
3.	**Perceptions on cost effectiveness**
3.1	Money saving
3.1.1	Free software
3.1.1.1	Straight forward
3.1.1.2	Convenient
3.1.2	Saving travel-related expenses
3.1.2.1	No need for transportation
3.1.2.2	No need to eat outside
3.2	Time saving
3.2.1	Reducing transportation time
3.2.1.1	More time to practice
3.2.1.2	Class begins on time
3.2.2	Flexible location
3.2.2.1	Can have class at any place
4.	**Perceptions on access**
4.1	Internet quality
4.1.1	Network speed
4.1.1.1	Latency affects the fluency of communication
4.1.2	Network connection
4.1.2.1	Stable internet reduces number of pauses
4.1.2.2	Avoid interruption from another app
4.2	Use of the app
4.2.1	Simple
4.2.1.1	Download and login in advance
4.2.1.2	App demonstration by teacher
5.	**Perception on video transmission**
5.1	Sound quality
5.1.1	Distorted sound
5.1.2	Emotion not fully delivered through sound
5.1.3	Noise from the environment
5.2	Video image quality
5.2.1	Small screen, small image
5.2.2	Image clarity is not the same as actual lesson

5. Discussions

5.1 Main Findings

For Research Question 1, this study found that despite the face-to-face model is still the main learning method, synchronous virtual classroom has been adapted by many music schools and universities (including HNU) around the world as an alternative teaching method for musical instruments such as French horn. In this study, an 8-week synchronous virtual classroom course with a detailed lesson plan via the app Dingtalk was constructed, it allows live video transmission and enables lessons on be held online. For Research Question 2, specifically for performance improvement, the results of the quantitative analysis show that the synchronous virtual classroom learning method can significantly improve students' overall performance, and specifically, significantly improve their performance in 6 criteria, they are integrity of music, rhythm, fluency, performance skill, mastery of music style, and emotions; as for perceptions, students were generally satisfied with their synchronous virtual classroom learning experiences. The positive perceptions from the students show that they think that this learning approach is generally effective and acceptable for them.

5.2 Discussion on the Findings

As for the 4 performance criteria that have not been significantly improved, a common point is quite noticeable, as they all closely related to physical guidance in traditional French horn pedagogy. The traditional teaching of the "Playing Posture", "Breath Control", and "Mouth Shape" in the face-to-face classroom often requires physical guidance from the teacher, for example, if a students' playing posture is wrong, the teacher can make in-time corrections by personally adjusting the students' body and hands. Moreover, the quality of "Intonation" can also be influenced by the 3 criteria mentioned above. Being able to make physical adjustment during face-to-face interaction in French horn teaching is crucial (Riley, 2009), however, the virtual classroom approach does not enable physical guidance. Even though the virtual classroom provides the video version of both the teacher's and students' physical conditions, as students mentioned in the interview, echo, time delay, unstable video quality still limits the quality of the guidance related to physical conditions, which then reflected in their performance scores in these criteria as not been significantly improved.

Besides the main findings obtained to answer the research questions, 3 additional findings were also found during data analysis. First, it is found that emotions, although can be better demonstrated in the face-to-face classroom, can also be improved via synchronous virtual classroom, as the students can learn from the teacher's words and guidance about what suitable emotions should play out from the music pieces. Second, this study found that in the synchronous virtual classroom, reducing pauses called while a student making mistakes during practice, can help the students' formal performance in terms of music piece completion. Third, parallels with the findings from Brandstrom et al. (2012), the group learning model is not suitable for synchronous virtual French horn classes unless using a platform that can mutualize the network latency and enable the multi-player performance. Thus, despite having numerous advantages both in terms of improving students' performances and perceptions of learning, synchronous virtual classroom learning approach cannot fully replace face-to-face learning approach but can be regarded as an applicable alternative for French horn students.

5.3 Implications for Practice

This research provides unique findings in the academic field of French horn teaching and learning. The findings show that synchronous virtual classroom is mentally acceptable for the students and can bring significant improvement to students' overall performance and to some specific techniques. Also, the findings provide guidance to the music faculties and French horn teachers regarding the pros and cons of the synchronous virtual classroom in terms of French horn pedagogy.

5.4 Future Research

An applicable direction for future research could be expanding the scope of research, such as increasing the number of sample students and selecting sample students from different universities, across the country, or from different countries. Another direction could be conducting research with different musical instruments under the synchronous virtual classroom, as they may generate different results and could be valuable for developing pedagogy in their specific fields.

6. Conclusion

With the important role of French horn in the symphony orchestra, it is undoubtedly vital to keep the academic attention of the music world on French horn teaching and learning. French horn teachers often manage their students' courses and practices through their teaching experiences, without referring to any related theories or academic findings, so the teaching plan often remains a considerable degree of subjectivity and could negatively affect the quality of teaching and learning (Fan, 2019). Gruhn (2022) defined the criterion of using digital technologies in music education as how much a digital tool stimulates the students' musical thinking, hearing, and performing, and how it acts on the students' mental states and cognitive processes. This study used both quantitative and qualitative research method to analyze, both statistically and mentally, on how synchronous virtual classroom affects the French horn students' performance and perception. Hopefully, the findings of this research could trigger more initiatives and future research in the academic field of French horn teaching and learning and provide suitable guidance to the individuals and faculties that need relevant references and assistances.

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