Integrated Technology Scaffolding Guides Students into the ZPD
A Case Study of Online Solfeggio Class

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Abstract. The development of online education provides a new form of teaching and learning for teachers and students. In China, the number of people using online education continues to increase, but the efficiency and pedagogy of online teaching and learning should be noticed. This study is based on the development of online education in China and aims to explore how scaffolding using integrated technology guides students into the Zone of Proximal Development (ZPD) in online Solfeggio classes. Two junior high school students volunteered to participate in this case study. Data were gathered from video analysis of classes, in-depth interviews with students, and assessment results of students in pre-class and post-class. Study results indicate that (1) Rhythmic scaffolding using online collaborative brush markers can help students stabilize their rhythm and move into the ZPD; (2) The pitch scaffolding played on the piano and the Sibelius score play facilitate students to find the fixed pitch and improve the pitch accuracy of the sight-singing; (3) Both students benefited from the online scaffolding instruction, but it shows individual differences in the effectiveness of guidance for different levels of students. Finally, what can be confirmed is that the scaffolding in the online Solfeggio course has positive impacts on the students, but the problem of sound latency on the Internet needs to be addressed in the future.

Keywords: Online education · Music class · Solfeggio · ZPD · Scaffolding

1 Introduction

The fast development of the Internet has produced numerous benefits to education [1]. Especially in the influence of the epidemic, many courses have shifted to an online teaching model. Referring to the origination of online education, Mclsaac and Gunawardena mentioned that the first major correspondence program in the United States was established in which the teacher and learner were at different locations at the University of Chicago in the late 1800s [2]. The most effective form of instruction in those days was to bring students together in one place and one time to learn from one of the masters. Later, radio and media were used in distance education due to the rise of various technologies. Then with the development of digital technology, online education becomes more popular. In fact, online education is one of the most dynamic and enriching forms of learning that exist today, which overcomes the time and place constraints that restrict

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access to instruction in traditional educational settings [3]. Furthermore, technologies provide an opportunity to integrate activities, which take place in informal and formal environments; and provide all users the possibility to act as constructors of knowledge, instead of just receivers [4]. Online education offers a lot of convenience for instructors and students compared to traditional education. Through the use of synchronous interactive online instruction, teachers may engage students and enhance the quality of student learning [5]. These demonstrate that online education can be a viable approach to provide convenience for teachers and students, as well as optional teaching and learning options.

In the field of online music teaching, many researchers have studied various aspects. Hebert discussed the format of online music courses, and he suggested that online courses typically are rich in audiovisual content, with music recordings, video images, and animated graphics, all of which can be displayed as many times as necessary, according to the needs and interests of individual students [6]. Shoemaker and Pike conducted a practical study of online piano teaching. Shoemaker pointed out that using existing technology to teach piano lessons synchronously could be seen as a viable method of reaching underserved populations in remote areas [7]. Pike studied the possibility of online synchronous piano teaching as an educational student internship [8]. Ruthmann identified the use of online collaboration tools to facilitate music learning in online music classes [9]. Cremata and Powell experimented with online collaboration between students and external musicians for creative work through technologies [10]. In the study about online Solfeggio instruction, Pike and Shoemaker compared online piano instruction with face-to-face instruction on students' acquisition of sight-reading skills [11]. They suggested that both groups benefited from improved rhythmic security and reported an increase in persistence, enthusiasm, motivation, and confidence following treatments. Brown discussed the improvement of students' sight-singing skills with New SmartMusic in the online virtual class [12]. The results of these studies show that these practices have positive effects.

However, the learning efficiency of online music teaching and learning should be discussed. Burnard suggested that the central aim of how to effectively practice music education in the new e-learning environment is imperative [13]. Parsons-Pollard, Diehl Lacks, and Hylton-Grant argued that face-to-face students perform better overall than online students in terms of learning outcomes for online instruction [14]. To make online teaching more efficient, some researchers have presented their ideas. Sun and Chen pointed out that well-designed class content; motivated interaction between the instructor and learners, and well-prepared and fully-supported instructors will make online instruction more effective [1]. And also, Smith et al. indicated that a significant difference in the efficiency of learning between face-to-face students and online students that favored the online instructional method [15]. These show that teacher instruction can help students learn more effectively in online teaching. Brindley, Blaschke, and Walti also considered that instructional strategies can be an effective motivational tool to encourage participation and enhance learning efficiency [16].

To this end, there is an imperious requirement to develop online pedagogy. Salavuo believed that technology should be viewed as a medium for pedagogical development in

education [4]. Moreover, Vygotsky proposed a theory in 1978: Zone of Proximal Development (ZPD). He defined it as the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers [17]. Bruner developed this theory to emphasize discovery learning in learning [18]. The guidance of ZPD and scaffolding for teaching is not only applicable to offline teaching but also applicable to online teaching. Hall used the theory of ZPD to build a complete student-centered online course [19]. Linked to this should be the scaffolding, which is typically used in ZPD practice. In general, scaffolding is construed as the support given by a teacher to a student when performing a task that the student might otherwise not be able to accomplish [20]. When faced with difficult problems that students cannot solve, scaffolded learning has served to increase instructor-student dialogue to improve students' capabilities through the cultivation of autonomous practices [21]. Scaffolding can also be used as a practical teaching method in online music learning.

When a music teacher is trying to teach students online, some pedagogical approaches should be mastered by them to enhance student learning efficiency. Scaffolding can be used as a pedagogy method in the online Soffeggio teaching process and guide students to approach the ZPD. Prior research with online education, ZPD, and Scaffolding presented rich results from the respective perspectives. But there is still a lack of research on the combination of the three in the direction of music education. For this purpose, one hypothesis is proposed that scaffolding using integrated technology can be effective in guiding secondary music students into ZPD in online Solfeggio lessons. In the current situation of online education in China, teachers mostly use WeChat videos, Tencent videos, etc. to teach online. Some teachers believe that "lack of interaction between teachers and students", "teaching contents are not suitable to be presented online", and "teachers' teaching design and organization skills are insufficient" are the main reasons for students' reduced effectiveness in online learning [22]. Although this learning model practically achieved online teaching, it also has many shortcomings, which increased the cost and risk of online learning for students. In addition, little research has been done on the pedagogy of online Solfeggio teaching. This study mainly combines three aspects of online education, ZPD, and Scaffolding to guide the online Solfeggio lessons and to explore its practical effects.

2 Methods

The participant were two students from a junior high school in Changsha, Hunan, China who volunteered to participate in this experiment. In order to distinguish these two students and to protect their privacy, Student 1 and Student 2 will be used to present their names. This study focused on the theoretical foundations of ZPD in an online Solfeggio class and concentrates on how technology can be used to create scaffolding to help students move into the ZPD. The class format was one-on-one online. The teacher was an experienced music teacher and the students were all art majors with some musical foundation but had never taken online Solfeggio lessons before. The teaching place was in the piano room of a music institution, whereas the learning site was at home due to

the epidemic blocking measure. Both students are female, 15 years old, extroverted, a beginner who has been studying music for half a year but have different capacities with sight-reading skills. They were required to take a forty-five-minute online experimental Solfeggio lesson and were given the same instructions. In the online teaching and learning process, some of the techniques were used:

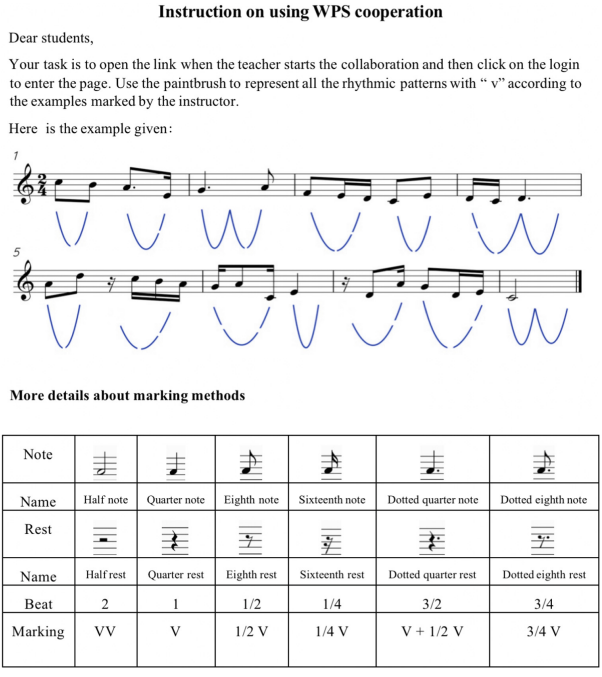
- Instrument: Piano (For pitch instruction)
- Equipment: Laptop/computer (To connect to the Internet, carry videos and teaching software)

Teaching software: Zoom (For video conferencing), WPS cooperation (For collaboration between students and the teacher).

- Internet: Wifi (For connecting two computers)
- Composition software: Sibelius (For score creation)
- Frequency testing application: Singscope (For measurement of pitch)

The teacher wrote written instructions to guide students on how to make marks, as shown in Fig. 1.

This is a case study, and the method of qualitative research was used. Data were collected from video recordings of two online Solfeggio classes and in-depth interviews with two students. The video was recorded in real-time from the point of view of the



Instruction on using WPS cooperation

Dear students,

Your task is to open the link when the teacher starts the collaboration and then click on the login to enter the page. Use the paintbrush to represent all the rhythmic patterns with " v" according to the examples marked by the instructor.

Here is the example given:

1

5

More details about marking methods

Note						
Name	Half note	Quarter note	Eighth note	Sixteenth note	Dotted quarter note	Dotted eighth note
Rest						
Name	Half rest	Quarter rest	Eighth rest	Sixteenth rest	Dotted quarter rest	Dotted eighth rest
Beat	2	1	1/2	1/4	3/2	3/4
Marking	VV	V	1/2 V	1/4 V	V + 1/2 V	3/4 V

Fig. 1. Marking instruction for students

teacher who opens it from her equipment. It included the video dynamics between the teacher and the students, the sharing of the teacher's courseware and instruction, and the collaborative process between the teacher and the students. Students will be instructed in the use of online learning technology software before the class. Then, a simple staff scale will be used to test the students' sight-reading skills. Afterward, some scaffolding instruction will be given to improve the students' rhythmic stability and lead them into the ZPD. Finally, a comparative analysis was used to measure student learning performance after the end of the class.

3 Results

After analyzing the experimental data and video observations, the results are found to be divided into the following aspects: pre-class assessment of students' current level, use of rhythmic scaffolding (brush markers on a collaborative platform) to help students stabilize their rhythms, use of pitch scaffolding (piano and Sibelius score play) to help students calibrate their pitch, and online scaffolding for integrating technology to help guide students into ZPD and expand the range of knowledge already acquired.

3.1 Pre-class Assessment of Students' Current Mastery of Sight-Reading Skills

To understand the students' acquired knowledge and to make a better instructional design, students' existing abilities are assessed by sight-singing scores. It is presented online and consists of three parts: rhythm struck, scale singing, and melody singing. Related to the rhythm struck, the teacher strikes different rhythmic patterns online, followed by students imitating the strumming. The pitch accuracy test is a fixed scale singing. Four scales (a C major scale, a G major scale, an a minor scale, and an e minor scale) are tested. The teacher plays the first note of each scale, and then the students sing spontaneously while the teacher records the students' pitch accuracy simultaneously. The rhythm and pitch accuracy abilities of two students for each scale presented are in Table 1.

The total scores in the above table show that Student 1 has better-fixed pitch ability than Student 2. Student 1 has an outstanding performance in the C Major scale and a minor scale. However, she does not perform so well in the G Major and e minor scale, earning 10 and 12 points. Compared with the pitch of student 2 is also better in the first two modes, but she cannot sing accurately in the last two modes.

Except for the above-mentioned tests, a basic Solfeggio scale is given on the online teaching platform to test students' combined pitch and rhythmic ability. In addition to

Table 1. Score of scale testing correctness

	Scale in C Major	Scale in a minor	Scale in G Major	Scale in e minor	Total
Student 1	15	15	10	12	52
Student 2	14	13	6	2	35

Note: A correct pitch represents 1 point, a whole up and down scale represents 15 points. 60 overall.

Table 2. Score of rhythm testing correctness

Rhythm pattern									
Name	Too	Ta	Ti-Ti	Ti-Ka-Ti-Ka	Tum-Ti	Ti-Ti-Ka	Ti-Ka-Ti	Syn-Co-pa	Ti-Ka-Ka
Student 1	1	1	1	1	0	1	1	0	1
Student2	1	1	1	0	0	0	1	0	0

the pitch scores shown in Table 1, their ability is assessed in terms of rhythmic stability. Nigh rhythmic patterns appear on this test, “Too”, “Ta”, “Ti-Ti”, “Ti-Ka-Ti-Ka”, “Ti-Ti-Ka”, “Ti-Ka-Ka”, “Ti-Ka-Ti”, “Tum-Ti”, “Syn-Co-Pa”. Student 1 scored 7 points for the number of times each rhythmic pattern appeared, with incorrect rhythmic patterns are “Tum-Ti” and “Syn-Co-Pa”, and rhythmic errors are found to be the playing of two-fear rhythmic patterns as one-beat rhythmic patterns and insensitivity to judging the timing of the rhythm. Compared with Student 2 scored 4, with incorrect rhythm patterns are “Ti-Ka-Ti-Ka”, “Syn-Co-Pa”, “Tum-Ti”, “Ti-Ti-Ka”, “Ti-Ka-Ka”. She is just as insensitive to rhythmic timing as Student 1 but makes more mistakes than Student 1. For example, she tends to play “Ti-Ka-Ti-Ka” as “Ti-Ti-Ti-Ti” and cannot tell the difference between “Ti-Ka-Ka” and “Ti-Ti-Ka”, as shown in Table 2.

As explained by the ZPD scope, the range of students before the online scaffolding instruction can be shown in Figs. 2 and 3. The inner circle represents the abilities that Student 1 and Student 2 have already mastered, the outer circle represents the range of ZPD (the range of abilities that can be mastered with the help of teachers and more capable peers), and the two hexagons represent pitch and rhythm, respectively. From the previous rhythm, pitch, and general tests, the ZPD scopes of the two students are as shown in Figs. 2 and 3.

The Figs. 2 and 3 show the competencies that students have mastered and the status of their immediate area of development before online scaffolding. The data shows that Student 1 has better pitch, rhythm accuracy, and sight-singing skills than Student 2.

3.2 Rhythm Scaffolding: Using Paintbrush to Improve Students’ Rhythmic Accuracy

The students’ existing abilities are tested before the class. To further improve the rhythmic stability of the students’ sight-singing, an online rhythm scaffolding instruction method is set up to help students stabilize the rhythm by using a collaborative paintbrush and marking with the teacher’s instruction. In addition to the text instruction, the teacher also provides online instruction and demonstrates the use of markers for students to better understand the scaffolding. As before, the teacher plays the first note on the piano as the students perform each melody. All of the first passages are sung unaccompanied. After the first trial, students are asked to use the paintbrush to mark the rhythm of the stave. The marking instruction is shown in Fig. 1 and Students follow the teacher’s standard drawing of markers such as in Fig. 4.

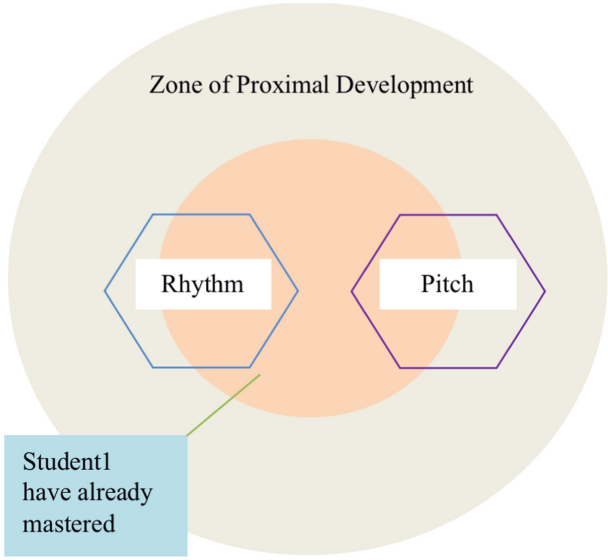


Fig. 2. ZPD of student 1 before Scaffolding

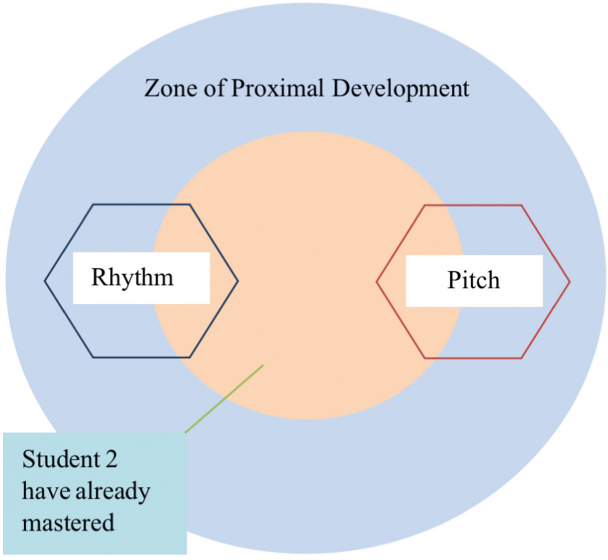


Fig. 3. ZPD of student 2 before Scaffolding

The experiment results suggest that the use of paintbrushes does have the effect of helping students to stabilize the beat. According to Student 1, markers allow her to avoid distractions and concentrate on pitch accuracy. She has been concerned that the online marker tool would not be as flexible to use as the pen in face-to-face learning. However, the results of the experiment show that online markers are equally effective.

Fig. 4. Solfeggio score with markers by students

Using the marker allows her to respond quickly to appropriate rhythm patterns, and the marker is the equivalent of a visual guide, reducing her reaction time. In addition, the same experiment worked on Student 2. In the teacher's previous test, the sight-singing ability of Student 2 is weaker than that of Student 1. The most significant promotion for her online rhythm learning is the mastery of the pattern "Ti-Ka-Ka" (The first rhythm pattern in the first bar of Fig. 2). She also expresses concern about her insensitivity to rhythmic patterns and not knowing how to sing them correctly. Like she frequently sings "Ti-Ka-Ka" incorrectly as "Ti-Ti-Ka" (The second rhythmic pattern of the fifth bar of Fig. 2) when trying for the first time. The marking provides her with an effective scaffold, and after a dozen imitations of tapping, she begins to slowly master this rhythm pattern, which propelled her into the ZPD.

The rhythm scaffolding used online above has the positive effect of guiding students with different bases into ZPD. However, there is also evidence that this brush marking approach seems to have a farther-reaching effect on driving students with a weak foundation into the ZPD. More precisely, markers are rhythmic stabilizers for Student 1, who mastered the method at a fast pace during the experiment and performed steadily in several later sight-singing examples. Therefore, the range of ZPD before the use of scaffolding has changed into the range of ability she has mastered. However, this scaffolding does not have the same driving range for Student 2, and it also drives her into the ZPD range, but the new rhythmic patterns mastered and the stability of the tapped rhythms can continue to improve. As a result, she already mastered abilities to go further into the ZPD range.

3.3 Pitch Scaffolding: Using Online Piano and Sibelius Score Play to Improve Students' Pitch Accuracy

Pitch accuracy is the other important aspect to be addressed in a Solfeggio course in addition to the rhythm. Based on the ZPD range of two students, pitch scaffolding using online piano and Sibelius score play is used for online instruction as a means of calibrating students' pitch. In this study, the online piano is used as the primary means, and the Sibelius score play is used as a secondary means. Scale construction is used to train students in fixed pitches before sight-singing. The teacher reinforces students' impressions of fixed pitches by repeatedly leading them in singing scales. The reason for using two approaches to adjust students' pitches is that online simultaneous Solfeggio teaching is largely limited by the network. The teacher cannot hear the students' vocal feedback synchronously while playing the melody continuously but typically hears her

piano sound due to the issues of asynchronous sound transmission and the latency of the network. More specifically, an unavoidable time gap occurs when the teacher plays the piano synchronously and the students' voices are asynchronous with the piano sound. Moreover, the teacher is unable to keep concentrate on the students' learning status when she is playing the piano. Therefore, there are times when the teacher has to abandon the piano for the sake of teaching effectiveness and use electronic devices to play the score examples to teach students. At this stage, the software can play the score to be able to select the sound and also pay attention to the student's dynamics although the asynchronous nature of the sound transmission cannot be avoided, which is a supplementary way of teaching Solfeggio class with piano online.

Comparisons are made between students before they sing the melody and after they sing completely without mistake. It concludes that online pitch scaffolding is effective in promoting students' pitch and guiding them into ZPD, but that there are individual differences. The test of singing melody is in C major, 2/4 beat, with eight bars in the hole score. A comparison of the error rate of the first rendition and the time taken to complete the last rendition after the online pitch scaffolding instruction is shown in Table 3.

As in the case of the information presented in the table above, the pitch scaffolding of using the online piano and Sibelius score play for the online class helps guide students to master the fixed pitch and enter the ZPD. Student 1 demonstrated a faster completion efficiency than the slower efficiency of Student 2. This performance is attributed to the fact that Student 2 has a weak ability of fixed pitch. Therefore, additional scaffolding and more patient instruction are needed, such as instruction with online piano scales and real-time teacher demonstrations. The comparison of the students' pitch learning efficiency is shown in detail in the experiment, as student 1 has the incorrect pitch "b^1" in bar 5 and the "f^1" in bar 6 (Fig. 4). She quickly finds the fixed pitch when she is asked to use the interval construction to find the tones. However, student 2 demonstrates the ability to find notes using only the C major ascending scale. When asked to find "f^1" (Fig. 4, bar 6), she typically looks up from "c^1" and could not find it with the previous note, "g^1" (Fig. 4, bar 6). Therefore, specialized pitch scaffolding for scale construction practice should be given through the online piano and Sibelius. Because of this weakness, Student 2 finds it difficult to keep up with the pace of the lesson, especially with the delayed sound transmission on the piano. Also, it is difficult for the teacher to notice that the student is not keeping up with the instruction, especially when playing the piano in sync. Yet the example of playing a score with Sibelius can instruct students without interfering with teacher-student interaction, even if its performance is not as flexible as simultaneous piano instruction.

Table 3. Error rate and completion time of students

	Error rate of the first trying	Time of completion
Student 1	18.75%	5 min and 13 s
Student 2	75%	19 min and 30 s

In conclusion, the above study uses both online piano and Sibelius pitch scaffolding to help students improve their pitch accuracy. The experiment proved that Sibelius can be used as a complementary means to guide students into ZPD when the online piano has deficiencies.

3.4 Post-class Assessment of Students

After students have gone through the teacher's online scaffolding instruction on rhythm and pitch, students are asked to try to sing a new sight-singing score using the scaffolding they have learned as a post-class assessment. The purpose is to check their current pitch rhythm accuracy and the range of their ZPD. The assessment of both students shows a positive result. Student 1 can sing a full, rhythmic 8-bar score with paintbrush markings, and after scaffolding the pitch and rhythm, a huge improvement could be seen. And with a fixed-pitch accuracy for the note "g^1", which is easily out of tune in her previous assessment. For Student 2, her improvement is smaller than that of Student 1, but the post-class evaluation also shows the effectiveness of online scaffolding. On the same melodic test, the better rhythmic accuracy is shown in Student 2 after the teacher's online pitch scaffolding. And also, she shows an equal ability to use markers to help herself stable the rhythmic pattern, but it takes her several repetitions of the "Ti-Ka-Ka" rhythm, which she does not know to get it correctly in the new pitch before. During this time, the mistake of playing "Ti-Ka-Ka" as "Ti-Ti-Ka" still appeared, but she can realize it and corrected it gradually, getting herself into the previous ZPD range.

When testing their pitches, Student 1 mastered most of the fixed pitches in the melody and was able to realize that a few tones were out of tune, but found through interval construction. Student 2 was able to find some pitch with the help of the scale scaffolding given by the teacher earlier, but his perception of fixed pitches was still not strong enough. For example, after getting the exact pitch of the "a" note with the help of the scaffold, she was able to sing it accurately the first time. But out of tune when she encountered this note in another rhythm pattern. The pitch scaffolding for the scale construction did help her, but she needed the teacher to provide the scaffolding in tandem when she could not find the correct pitch on her own. Overall, her pitch errors have improved from the previous, and her ability to sight-singing skills has improved.

The student's range of current abilities after instruction and the range of ZPD are shown in the Figs. 5 and 6.

The above chart shows the students' skills that have already mastered and the ZPD range for both students. It is clear that online scaffolding through integrated technology is effective for the online Solfeggio course. Student 1, however, was a better learner, including her mastery and use of rhythm and pitch scaffolding. Student 2 was also able to learn the scaffolding online which helped improve her sight-singing skills. In conclusion, online scaffolding of pitch and rhythm is effective for both students, but the learning effect shows individual differences.

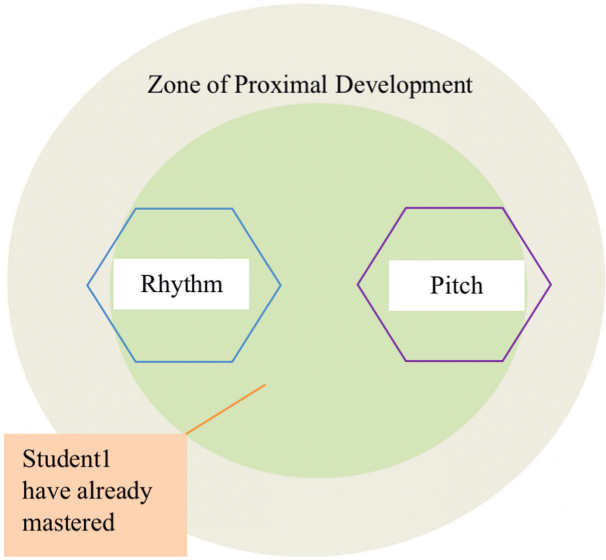


Fig. 5. ZPD of student 1 after scaffolding

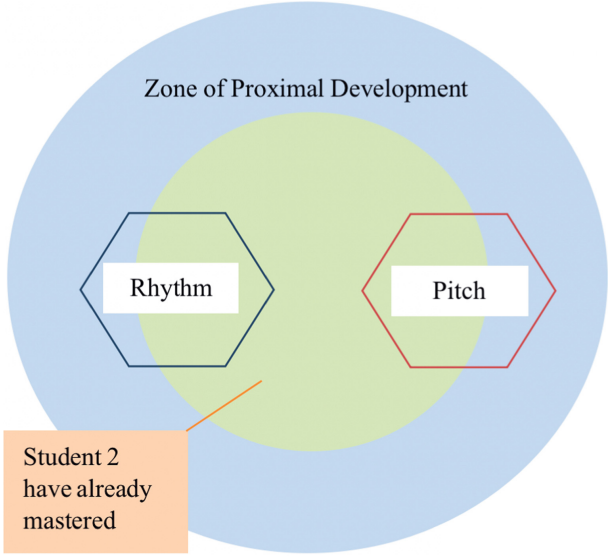


Fig. 6. ZPD of student 2 after scaffolding

4 Discussion

4.1 Concerns About the Technology

The students expressed their concerns about technology before the online class began. Both students expressed that they had never experienced taking an online Solfeggio class before and were concerned that they would not be able to use the instruction given by the teacher. Also, students wasted a lot of time finding out how to use the technology and the process of using it. In addition, the testing results of online classes are highly dependent on the stability of the network. During the teacher's online lesson with Student 1, the network connection was down three times for a total of 15 min. Student 1 indicated that she was very satisfied with the effects of the online video Solfeggio course and was very interested in learning online, but the instability of the network affected her learning experience. Student 2 wasted lots of time in the process of downloading and installing the video software. The online course was too unfamiliar to her compared to face-to-face instruction. The process of installing the program and using it became time-consuming, which gradually made her less excited about the online course even though she had high expectations at the beginning. In short, the process of online teaching is always affected by some factors, and cannot be connected as closely as the process of face-to-face teaching.

Moreover, there seem to be some flaws in the process of online video lessons. Online video sight-singing instruction is also dependent on sound synchronization. In fact, timely feedback from the teacher is needed when students have pitch or rhythm problems while singing. However, video lessons have network delays and the teacher is unable to catch the students' status in real-time. Student 2 stated that sometimes she could not keep up with the teacher's synchronized lead singing during the lesson. It was difficult to synchronize the teacher's voice with the student's voice due to technical reasons, but the teacher cannot solve this problem. Therefore, more synchronized sound software needs to be developed to solve the sound delay problem in future research, which will be more beneficial to the development of online music teaching and learning.

4.2 Psychological Reasons Affect Online Learning Efficiency

In addition to the effects of the techniques described above, the results of this study may be influenced by other factors. For instance, the students' personality traits will affect their learning efficiency. Both students are extroverted, but their resilience to cope with stress differed. Student 1 is more optimistic when facing difficulties. Notably, Student 2 is a weaker psychological quality when facing stress, and the researcher learned from the in-depth interview that she may be afraid of bad singing performance. The reason is from the teacher in the off-line school because she is very strict if she could not sing well. More specifically, during her face-to-face Solfeggio lessons at school, the teacher would interrupt her if she sang the wrong note or played the wrong rhythm. She could not come back from the wrong measure and had to start over if the teacher interrupted. This performance is also present in online instruction. For this reason, the teacher used scaffolding repeatedly to get her pitch back. This habitual fear may also have had an impact on the results of the study.

5 Conclusion

This study explores the practice of using integrated technology of rhythm and pitch scaffolding to guide students into the ZPD in online Solfeggio courses. The study is conducted with two middle school students who have never taken an online music course with differences in the foundation sight-singing levels. The results demonstrate the effect of both the rhythmic scaffolding (collaborative platform paintbrush markers) and pitch scaffolding (online piano, Sibelius) of the integrated technology in enhancing students' pitch rhythmic stability. There are still some limitations present in this study. Broader data is required to demonstrate the usefulness of student scaffolding regarding teacher set-up in long-period online Solfeggio courses, and some comparative research on online and offline education can be conducted. In addition, due to technical issues in online education, students' pitch measurements may not be precisely recorded. Since the analysis of the voices in this study is done through online videos. The voices may be distorted or intermittent due to problems with the online equipment, which may have an impact on the analysis of the study results. The researcher would like to have a stable network and quiet environment for online teaching and learning to reduce the impact of unstable networks and noise on the study results. Unfortunately, this problem cannot be avoided in the current online education.

It is hoped that more technical, as well as equipment problems of online education, can be solved, a systematic online music education platform can be established, and the quality of sound transmission can be improved to better promote the development of online music education in the future. In addition, more research is needed to focus on the changing roles of teachers and students in online music education, where there is more autonomy than in face-to-face teaching, and where students can gather information and create on their own. Therefore, what is necessary is to study the pedagogy of online teaching to better accommodate the growing phenomenon of online teaching. Finally, attention needs to be paid to student aspects such as the interest, the willingness to learn online, and the learning abilities and differences to enhance the effectiveness of online education. This means that teachers should pay attention to students' learning behaviors, emotions, and current knowledge to set up content and interactive tasks to help students enter the ZPD.

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