Perception of Musical Intervals through Mobile Learning Model Based on the Scaffolding Strategy with Separating Single Note Building

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Abstract. The study on musical interval perception using a mobile learning model with a scaffolding strategy highlights the advantages of integrating mobile learning systems (MLS) into music education. Research shows MLS and traditional tutoring achieve similar academic outcomes based on test scores. However, MLS significantly enhances students' self-efficacy and motivation, creating a more positive learning environment. These findings indicate MLS not only maintains academic performance but also boosts students' confidence, crucial for persistence and resilience in learning. The MLS group consistently scored higher on attitude questionnaires, demonstrating mobile learning's benefit in fostering supportive educational experiences. By employing the scaffolding strategy, MLS helps learners incrementally understand musical intervals, promoting deeper cognitive processing and retention. Mobile devices offer accessibility, enabling practice anywhere, catering to diverse learning styles and schedules, enhancing inclusivity in music education.

Keywords: smart mobile phone, musical intervals, scaffolding strategy

1 Introduction

Proficiency in understanding intervals is essential for musicians to excel, as it establishes a basis for comprehending the structure of music and mastering various musical skills[1, 14, 21]. By identifying intervals and training their ears to recognize them, musicians can focus on them more intentionally, making it simpler to identify chords and their variations by ear [12, 17, 23]. Music intervals also have a significant impact on how notes interact in music, making it a fundamental skill for musicians to cultivate [18, 19]. Therefore learning musical intervals by ear is essential for improving the ability to play melodies on the piano and sing more accurately. By mastering musical intervals, musicians can elevate their musical abilities and become more proficient in their craft.

Intervals are the building blocks of scales, chords, and melodies, serving as a measurement between two pitches [11]. However, distinguishing and naming musical intervals can be difficult, particularly for those new to music [7, 10]. Musical intervals refer to the distance between two musical notes, whether they are played simultaneously in a chord or sequentially in a melody. These musical intervals can vary in frequency, which may make them challenging to identify and recognize by ear. This paper proposes a mobile learning platform based on the scaffolding strategy learning theory to facilitate the learning of musical intervals.

1.1 Perception of Musical Intervals through the Scaffolding Strategy

Scaffolding theory offers a framework for understanding how individuals learn and develop cognitive skills within a social context [22]. This theory emphasizes the importance of social interaction and guidance in the learning process, suggesting that learners can achieve higher levels of understanding with the support of more knowledgeable peers or instructors. The concept of scaffolding in education provides support to students while learning a new concept or skill enhances their understanding. Scaffolding is a gradual strategy for building knowledge and skills, allowing students to reach their potential with guidance. This approach is based on Vygotsky's Zone of Proximal Development (ZPD), which highlights the difference between what a learner can do independently and what they can achieve with assistance [20]. Scaffolding is an instructional strategy that aims to support students in their learning process by providing the necessary guidance and assistance [6, 16].

Understanding intervals requires practice and the ability to hear them within a musical framework. Traditional musical interval pedagogy implements a common use of dissonant or unexpected intervals, cadences, and harmony, which can provide a new conceptual focus within pieces and extended musical understanding [2 8]. The difficulties in the traditional instruction site for learning music intervals requires distinguishing the two pitches in an musical interval requires good aural training and extensive practice to improve accuracy and sensitivity in interval recognition [4, 5]. Therefore, the learning of musical intervals can use the framework of the scaffolding strategy to separate the playback of two pitches of musical interval into the presentation of one pitch. This allows learners to construct the identification of musical intervals through single-note cognition.

Scaffolding strategy is the process of offering structured support like prompts, cues, modeling, or feedback to help learners reach their maximum potential. As learners gain more skills, the level of support from the scaffold is decreased gradually, enabling them to take more responsibility for their learning.

1.2 Potential Learning Benefits with Mobile Application

Mobile learning allows learners to learn and present music in more versatile ways, accommodating different learning styles and schedules [3, 13]. It enhances cognitive development and brain plasticity through intensive music listening and practice, making the learning process more dynamic and engaging [9, 15]. Beyond traditional music instruction, which often requires in-person classes, mobile learning provides the

convenience of accessing educational resources anytime and anywhere through online platforms.

Implementation of mobile learning could bridge the gap between traditional and interactive learning environments, offering a more engaging and flexible way to learn music. It not only broadens the scope of music education by incorporating digital tools and resources but also facilitates continuous learning outside the traditional classroom setting. This approach helps students develop their musical skills more efficiently by providing immediate access to a wealth of information and practice materials. With the popularity of mobile phones, mobile learning significantly enhances the music education experience, making it more accessible, adaptable, and effective for learners.

2 Mobile Learning System Development Strategy

The development of Mobile Learning System (MLS) for the musical intervals practicing is based on the learning theory of scaffolding strategy which separates the playback of two pitches of musical interval into the presentation of one pitch (Fig.1). This allows learners to construct the identification of musical intervals through single-note building.

The learning interface is shown as Fig.2**.** The user interface for MLS is created using App Inventor, while the server side is built with MySQL. This practice system could transform traditional musical interval learning settings, allowing users to effortlessly practice and customize their learning experience to their preferences and needs.

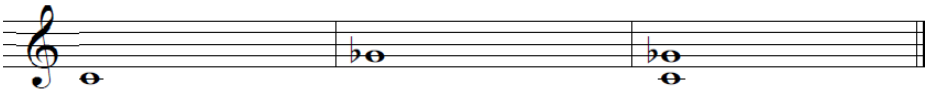

Fig. 1. Practice example of musical intervals

As the Fig. 2 shows, the user presses the “Playback” button and listens to the interval question, user can select the “Answer” button to display the screen of correct staff. The user can also repeatedly press the on-screen piano key to practice the two single pitches corresponding to the interval. This practice helps in identifying which two pitches compose a musical interval. This simplifies the learning of music intervals, enabling users to grasp them independently, free from the limitations of a conventional classroom setting with an instructor.

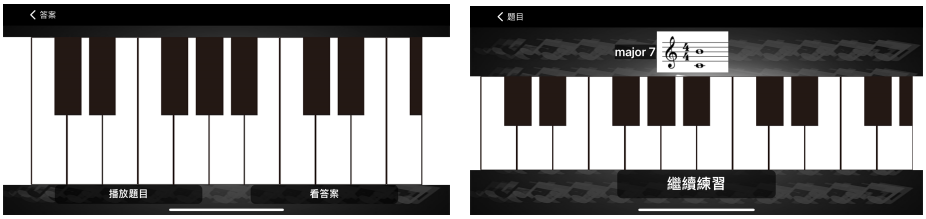

Fig. 2. Learning interface of Music intervals

The MySQL database management system is utilized on the server to store and administer the large volume of educational data generated by the learning system. MySQL is recognized for its stability, scalability, and reliability, making it an optimal choice for this task. It empowers the system to efficiently process multiple user requests concurrently, ensuring a smooth learning experience for users on various devices and locations.

3 Benefits of learning via MLS

The study involved 37 participating students who were randomly assigned to one of two musical interval learning settings. In the first setting, 21 students received instruction via a Mobile Learning System (MLS), while the remaining 16 students practiced musical intervals through traditional tutoring methods. This random assignment aimed to ensure an unbiased comparison between the two instructional approaches. The study spanned a period of 8 weeks, after which the students' knowledge and skills were assessed.

At the conclusion of the extracurricular course, all students participated in a standardized test designed to measure their understanding and proficiency in musical intervals. The test had a maximum score of 100, providing a clear and quantifiable measure of

each student's performance. Additionally, the students completed an attitude questionnaire that evaluated their learning motivation and self-efficacy. These factors are critical in understanding how students perceive their learning experiences and their confidence in mastering the material.

The primary objective of incorporating the MLS in this study was to examine its efficiency and effectiveness as a mobile learning setting for musical interval education. The study sought to determine whether MLS could offer a viable and potentially superior alternative to traditional tutoring. To achieve this, the research analyzed both the test scores and the attitude questionnaire responses of the students.

Table 1 presents a detailed comparison of the students' performance and attitudes across the two learning settings. The data is summarized using statistical measures, including the means and standard deviations of the test scores. These measures provide insights into the central tendency and variability of the students' performance, offering a comprehensive view of the effectiveness of each learning method. Additionally, the attitude questionnaire results, which correspond to learning motivation and self-efficacy, are also analyzed using means and standard deviations. This statistical analysis helps to illustrate the students' overall attitudes toward the MLS and traditional tutoring settings, shedding light on their preferences and perceived benefits of each approach.

By utilizing statistical terms and methods, the study provides a robust analysis of the efficacy of mobile learning systems in teaching musical intervals, thereby contributing valuable insights to the field of educational technology and pedagogy.

Table 1. Results of Test Score and Attitude Questionnaire

Learning Setting	Review Index	Mean	Standard Deviations
MLS	**Test Scores**	81.38	6.51
	Learning Motivation	3.41	0.58
	Learning Self-efficacy	3.89	0.41
Traditional Tutoring	**Test Scores**	79.81	7.66
	Learning Motivation	3.29	0.49
	Learning Self-efficacy	3.38	0.48

One-way ANOVA tests were conducted to compare students' test scores and assess differences between Mobile Learning System (MLS) and traditional tutoring methods. The results showed no significant difference in test scores between the two groups, indicating that both methods were equally effective in teaching musical intervals.

However, significant differences emerged in learning self-efficacy. Students in the MLS group reported significantly higher self-efficacy scores compared to those in the traditional tutoring group. This suggests that while both methods achieved similar academic outcomes, the MLS approach positively impacted students' confidence in their learning abilities.

Additionally, the MLS group consistently demonstrated higher scores on the attitude questionnaire, which measured learning motivation and self-efficacy, than the traditional tutoring group. These findings imply that the MLS method not only maintains academic performance but also enhances students' motivation and belief in their ability to succeed, creating a more positive learning environment.

4 Conclusion

The study on the perception of musical intervals through a mobile learning model based on the scaffolding strategy highlights the benefits of integrating mobile learning systems (MLS) into music education. The research demonstrates that both MLS and traditional tutoring methods achieve similar academic outcomes, as shown by the comparable test scores of students from both groups. However, the MLS method significantly enhances students' learning self-efficacy and motivation, creating a more positive and engaging learning environment.

The findings indicate that MLS not only maintains academic performance but also boosts students' confidence in their learning abilities. This is crucial as higher self-efficacy is linked to greater persistence and resilience in learning challenges. The MLS group's consistently higher scores on the attitude questionnaire underscore the advantage of mobile learning in fostering a supportive and motivating educational experience.

By leveraging the scaffolding strategy, the MLS approach allows learners to build their understanding of musical intervals incrementally, facilitating deeper cognitive processing and retention. The use of mobile devices offers the added benefit of accessibility, enabling students to practice and enhance their musical skills anytime and anywhere. This flexibility is particularly valuable in accommodating diverse learning styles and schedules, making music education more inclusive and adaptable.

Integrating MLS in musical interval education offers a promising alternative to traditional tutoring methods. It not only achieves comparable academic results but also enriches the learning experience by boosting student motivation and self-efficacy. The study underscores the potential of mobile learning to transform music education, providing a more engaging, flexible, and effective approach to developing essential musical skills. As the digital age evolves, incorporating mobile learning systems in educational practices is likely to become increasingly important, offering innovative solutions to traditional educational challenges.

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