



Mixed Reality–Enhanced Remote Cello Practice: Design, Prototype, and User Evaluation

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Abstract.

Learning string instruments such as the cello is notoriously difficult for beginners due to the challenges of intonation and bowing techniques, as well as the absence of clear physical guides. While textbooks and video materials provide visual information, they lack interactivity and real-time three-dimensional feedback. In this study, we propose a novel application of Mixed Reality (MR) and Holoportation to support remote cello lessons. We developed a prototype system using Microsoft HoloLens 2 and Azure Kinect DK to project a teacher's performance as a hologram into the student's visual field, enabling interactive and immersive instruction. A user study with 10 university students compared MR-based lessons with conventional video lessons. The results indicate that MR lessons were perceived as more effective in terms of interactivity, responsiveness, and real-time feedback, whereas video lessons were considered easier to use. Our findings highlight the potential of MR and Holoportation technologies to enhance remote music education, while also identifying challenges in usability, visual fidelity, and device accessibility.

Keywords: Mixed Reality, Remote Learning, Music Education, Cello Practice, Usability Evaluation, Holoportation

1 Introduction

Remote learning technologies have been increasingly adopted in music education. Online lessons via video conferencing platforms or pre-recorded tutorials are widely available, offering learners convenient access to instruction regardless of location. However, these approaches often suffer from critical limitations: the lack of interactivity, the difficulty of providing real-time feedback, and the absence of embodied presence between teacher and student. These shortcomings are particularly problematic for instrumental practice, where posture, bowing, fingering, and subtle gestures must be carefully observed and corrected.

Mixed Reality (MR) technologies provide an opportunity to address these challenges. Devices such as Microsoft HoloLens 2 can seamlessly blend virtual objects and remote participants into the learner's physical environment, creating immersive and interactive experiences (Microsoft, 2023)[1]. Moreover, Holoportation, developed

by Microsoft Research, allows real-time three-dimensional capture and transmission of people, making it possible for a teacher and student to appear in the same virtual space even when physically distant (Microsoft Research, 2016) [2]. Prior studies have shown that MR enhances collaboration and creativity (Schlagowski et al., 2023[3]; Kobayashi et al., 2022 [4]) and supports music pedagogy in contexts such as piano (Birhanu, 2017 [5]) and violin (Campo et al., 2023 [6]; Shiino et al., 2013 [7]).

Nevertheless, the application of MR to string instrument practice remains largely unexplored. Compared with keyboard instruments, string instruments such as the cello require continuous monitoring of complex three-dimensional movements, including bowing trajectories, fingering positions, and whole-body posture. Traditional video lessons, constrained by two-dimensional views, are insufficient for capturing these details and often fail to provide learners with immediate and precise corrective feedback (Heyen et al., 2022)[8]. Although some research has investigated AR or AI-assisted support systems for instrumental learning, there is still a lack of systematic studies evaluating the effectiveness of MR and Holoportation specifically for string instrument practice.

For cello learners in particular, several barriers hinder effective practice and instruction:

- It is difficult to correctly recognize how to hold the bow.
- Understanding and maintaining proper cello posture is necessary but challenging.
- When practicing side by side, the instructor's finger positions are often unclear due to distance.
- In face-to-face instruction, the instructor's movements appear mirrored left to right, making it difficult for learners to judge whether their own actions are correct.

To address these barriers, the proposed system adopts the following approaches:

- **Bow holding:** A 3D model of the correct hand position for holding the bow is displayed in MR, enabling learners to observe from multiple angles and intuitively align their own hand with the model.
- **Proper posture:** A 3D model of the correct body posture is projected in MR for reference and confirmation.
- **Visibility of finger positions and mirrored actions:** Learners can freely move or flip the instructor's 3D body model, resolving issues of visibility and left-right orientation.

Through these approaches, the system aims to remove obstacles so that beginners can continue practicing without frustration or discouragement caused by difficulties in understanding fundamental techniques. This study therefore presents the design, prototype, and evaluation of an MR-based remote cello practice system using Microsoft HoloLens 2 and Azure Kinect DK, and investigates its effectiveness through a controlled user study.

2 Related Work

Research on remote music education has expanded with the growing availability of online platforms. Video conferencing and pre-recorded tutorials have made it possible for learners to access music instruction independent of location. However, such approaches often lack immediacy and interactivity, which are essential for musical training where feedback on body movement and technique must be delivered in real time.

Recent studies highlight the potential of Mixed Reality (MR) and Holoportation for enhancing remote collaboration and learning. MR systems such as HoloLens enable immersive interaction by merging real and virtual spaces (Microsoft, 2023) [1]. Holoportation, introduced by Microsoft Research, captures a person volumetrically using depth cameras and transmits the 3D data in real time to a remote location, where it can be rendered through MR devices (Microsoft Research, 2016) [2]. This technique enables participants to share the same spatial environment as if they were co-present, overcoming many of the limitations of conventional video communication. Empirical work has shown that MR can foster collaboration, engagement, and creativity (Schlagowski et al., 2023 [3]; Kobayashi et al., 2022 [4]). In the medical field, Sekimoto et al. (2020)[11], with Chiba as a co-author, demonstrated the feasibility of interactive three-dimensional telemedicine using Holoportation, enabling remote clinicians to provide spatially accurate guidance during procedures. Although these advances highlight the versatility of Holoportation in domains such as telepresence and healthcare, its potential for pedagogy, particularly in music education, has not yet been fully explored.

Applications of MR and AR in music pedagogy are also emerging. Birhanu (2017) [5] proposed guidelines for piano teaching in MR environments, while Campo et al. (2023) [6] conducted a case study on violinists, highlighting the role of immersive interaction in motor imitation learning. These works suggest that immersive technologies can support music learning beyond traditional video-based methods.

String instruments, however, introduce unique challenges. Violin instruction has been supported through markerless AR to visualize bowing and fingering (Shiino et al., 2013) [7], and AR has also been explored for gesture training (Campo et al., 2023) [6]. Heyen et al. (2022)[8] developed immersive visualization techniques to capture three-dimensional cello bow trajectories. In addition, haptic interfaces such as the FireFader provide tactile feedback for string pedagogy (Berdahl & Kontogeorgakopoulos, 2019 [12]). In Japan, Yamaguchi et al. (2023)[10] developed a smart-glass–based support system for string instrument practice, demonstrating practical applications in educational settings.

More broadly, research on smart musical instruments envisions a future where traditional instrument design is integrated with sensing, connectivity, and feedback mechanisms (Turchet et al., 2019[9]). Such perspectives align with the goals of MR- and AI-enhanced pedagogy, where real-time analysis and adaptive guidance are central.

Despite these advances, few studies have systematically examined MR and Holoportation for cello practice. Most existing works focus on piano or violin, leaving a significant gap in string instrument pedagogy where posture and bow control are especially demanding. This study addresses this gap by designing and evaluating an

MR-based remote cello practice system, aiming to provide both theoretical insights and practical contributions to immersive music education.

3 Design and Implementation of a Mixed Reality Cello Practice Support System

This section presents the design and implementation of the proposed Mixed Reality (MR) cello practice support system. The system was developed to overcome the limitations of conventional remote instruction by enabling immersive interaction between learners and instructors. We describe the overall architecture, hardware setup, and software modules, followed by the learning support functions specifically designed for cello practice.

3.1 System Overview

The proposed system provides an immersive environment in which cello learners can receive remote instruction from teachers through Mixed Reality (MR). As illustrated in Figure 1, the system consists of two primary components: (1) the instructor side, where body movements are captured in three dimensions, and (2) the learner side, where the reconstructed instructor model and supplementary 3D guidance are displayed in MR.

On the instructor side, an Azure Kinect DK captures body posture and hand movements, including bowing gestures and finger positions. These motion data are transmitted in real time to the learner side using a holoportation framework. On the learner side, a Microsoft HoloLens 2 renders the instructor's 3D body model within the learner's physical practice environment. Learners can freely adjust the viewpoint, scale, and orientation of the instructor model, enabling detailed observation that overcomes the limitations of conventional face-to-face and video-based lessons.

To further support cello-specific skills, the system incorporates pre-modeled 3D references such as the correct bow grip and body posture. These models can be displayed alongside or superimposed on the learner's own view, providing intuitive feedback that helps learners align their movements with the target forms. The combination of real-time instructor projection and MR-based reference models allows learners to continue practice with a high level of engagement and reduced frustration. Figure 2 shows an example of the projected 3D instructor model as displayed through the HoloLens. Figure 3 illustrates a participant practicing the cello using the MR support system, highlighting how the virtual instructor and guidance models appear in the learner's physical environment.

3.2 Hardware Configuration

The system employs commercially available hardware components to ensure both accessibility and reproducibility. The configuration consists of three main elements: the motion-capture unit, the MR display device, and the network infrastructure.

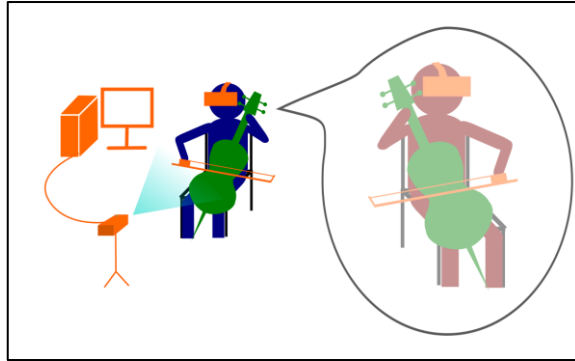


Fig 1. System configuration of the MR-based remote cello practice system

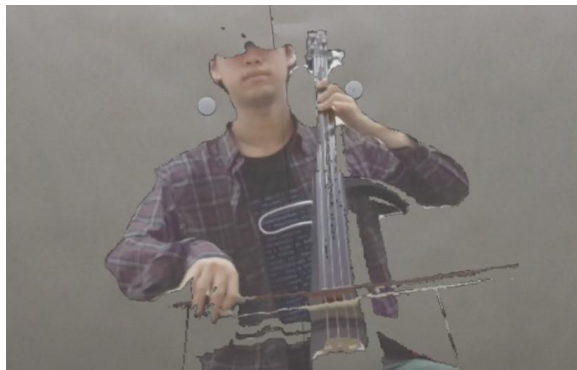


Fig 2. Example of the projected 3D instructor model displayed in HoloLens



Fig 3. A participant practicing the cello using the MR support system

On the instructor side, an Azure Kinect DK is used to capture body posture and upper-limb movements. The device provides depth sensing and skeletal tracking at a sufficient resolution to reconstruct detailed gestures such as bow grip and finger placement. The captured data are transmitted to the learner side in real time.

On the learner side, a Microsoft HoloLens 2 serves as the MR display device. The headset projects the instructor's 3D body model directly into the learner's practice environment. The HoloLens 2 also enables learners to manipulate the 3D model (e.g., scaling, rotating, or repositioning) using intuitive hand gestures. This capability helps address common difficulties in music instruction, such as mirrored perspectives and obstructed views.

For the prototype evaluation, a local area network (LAN) was adopted in order to minimize latency and packet loss, ensuring stable communication between the instructor and learner sides. This controlled environment allowed us to focus on validating the system's functionality without interference from unstable network conditions. In practical deployment, the system can be extended to operate over high-speed internet connections, enabling remote lessons across long distances.

The combination of Azure Kinect DK and HoloLens 2 provides a balance of accurate motion capture and immersive visualization, which is essential for cello pedagogy where fine-grained body control is required.

3.3 Software Modules

The proposed system integrates several software modules that operate in concert to capture, transmit, and visualize cello practice in MR. The software flow can be divided into three primary components: motion capture and processing, holoportation transmission, and MR visualization with interactive support.

Motion capture and processing: The instructor's movements are first acquired through the Azure Kinect DK SDK, which provides skeletal tracking data and depth maps. These data are processed to extract key features relevant to cello practice, such as bow trajectory, finger placement, and posture alignment. The processed data are converted into 3D mesh representations for transmission.

Holoportation transmission: A custom transmission module streams the 3D mesh and motion data to the learner side in real time. The data are optimized for bandwidth efficiency by reducing unnecessary polygons and compressing textures, thereby minimizing latency without degrading instructional fidelity.

MR visualization and interaction: On the learner side, the HoloLens 2 application reconstructs the instructor's body model and integrates it into the learner's environment. The application also manages the rendering of supplementary 3D reference models, such as a correct bow grip or posture template. Learners can interact with the models through gesture-based input, allowing them to rotate, scale, or reposition the instructor's avatar as needed.

Together, these modules provide a seamless pipeline from motion capture to MR-based visualization, ensuring that both the authenticity of the instructor's movements and the pedagogical guidance for cello learners are preserved.

3.4 Learning Support Features

To address the specific challenges faced by cello beginners, the system incorporates several learning support features that extend beyond simple hologportation. These features are designed to reduce common barriers such as unclear posture, difficulty recognizing hand and finger positions, and confusion caused by mirrored perspectives in face-to-face instruction.

Bow holding: A pre-modeled 3D representation of the correct bow grip is displayed in MR. Learners can align their own hand with the model from multiple angles, facilitating intuitive understanding of how the bow should be held.

Proper posture: The system provides a 3D reference model of correct cello posture, including body alignment and instrument position. Learners can compare their own appearance with the model, promoting consistent posture during practice.

Finger position visibility: In side-by-side practice, it is often difficult to see the instructor’s finger placement clearly. To overcome this limitation, the 3D instructor model can be freely rotated, zoomed, or repositioned by the learner, enabling detailed observation of hand movements that are normally obscured.

Mirrored movement correction: In face-to-face lessons, the instructor’s actions often appear mirrored left to right, leading to confusion when learners attempt to replicate them. The system allows learners to flip the instructor’s 3D model horizontally, eliminating this ambiguity and ensuring that the learner’s perspective matches the correct orientation.

By integrating these features, the system not only reproduces the presence of the instructor but also introduces novel pedagogical functions that are not available in conventional lessons. This approach is expected to reduce frustration and maintain motivation among beginners, supporting continuous practice and skill development.

3.5 Interaction Flow

This section describes how learners interact with the system during cello practice and outlines the internal functions and mechanisms that enable such interaction.

Learning scenario:

At the beginning of a session, the instructor’s movements are captured using Azure Kinect DK. These data are transmitted in real time and reconstructed on the learner side through the HoloLens. The learner observes the instructor’s 3D model directly in the practice space and can manipulate it to obtain the most effective viewpoint. By repeating observation, practice, and correction, the learner receives guidance comparable to face-to-face lessons, but with enhanced flexibility.

System functions and mechanisms:

The system incorporates the following core functions:

- Extracting color and depth information from the Kinect sensor.
- Processing the extracted data and generating 3D meshes.
- Recognizing hand and finger movements using Microsoft’s Holographic API.
- Creating and positioning 3D models in space based on the processed data.

- Transmitting the positioned data to the HoloLens via Wi-Fi for real-time display.

User interaction:

The system also provides intuitive gesture-based controls. A pinch gesture with the thumb and index finger allows the learner to move the projected model in midair, while a tap gesture flips the model front-to-back, correcting left–right orientation when necessary.

System improvements:

Compared to the initial prototype, several refinements were implemented to improve usability:

- Changing the default projection position of the model.
- Adjusting the Kinect’s capture distance to optimize performance.
- Adding the flipping function triggered by a tap gesture.
- Modifying the rendering so that the back side of the model, which was previously culled, is now visible when flipped.

Through this interaction flow, learners can flexibly manipulate the instructor’s model and supplementary references, thereby overcoming visibility and orientation problems that typically hinder remote instrument instruction.

4 User Study

To evaluate the effectiveness and usability of the proposed MR cello practice support system, we conducted a user study with novice cello learners. The study aimed to investigate whether the system could overcome the practical difficulties of traditional lessons and provide meaningful support for practice. In particular, we focused on learners’ perceptions of usability, the clarity of instructional support, and the motivational aspects of using MR technology. The following subsections describe the procedure, participants, and evaluation methods in detail.

4.1 Experiment Overview

The user study was conducted in a controlled laboratory environment at Future University Hakodate. Each session was carried out individually, with the instructor and learner located in separate but connected spaces to simulate a remote learning setting.

At the start of each session, the instructor’s body movements were captured using the Azure Kinect DK and transmitted to the learner’s HoloLens 2 in real time. The learner wore the HoloLens and observed the instructor’s 3D model while practicing cello exercises. Learners were able to freely manipulate the projected model (e.g., rotate, scale, or flip) to confirm the visibility of the instructor’s hand and finger positions.

Each session lasted approximately 30 minutes and was divided into three phases:

1. **Introduction:** The learner was introduced to the MR system and its functions, including gesture-based operations.
2. **Practice:** The learner practiced cello exercises while using the system, focusing on bow grip, posture, and finger positioning.

3. **Evaluation:** After the practice phase, the learner completed a questionnaire regarding usability, clarity of feedback, and overall experience.

This procedure allowed us to evaluate how effectively the MR system could support independent learning while reducing the need for continuous verbal instruction from the teacher.

4.2 Participants and Conditions

The experiment was conducted with 10 university students aged 19 to 23. Three of the participants were male and seven were female. Seven of the 10 participants had prior experience playing a musical instrument (e.g., piano, violin, trombone, or traditional Japanese drums), although none had formal training in the cello.

To eliminate bias from the order of the lessons, participants were randomly assigned to experience either the mixed reality lesson or the video lesson first. This counterbalancing ensured that the order of exposure did not affect their evaluation.

4.3 Experiment Procedure

The experiment consisted of two lesson conditions, a video-based practice and an MR-based practice, followed by a comparative survey. The order of lessons was randomized for each participant to eliminate order bias.

- **Video lesson (20 minutes):** Participants practiced while watching a pre-recorded instructional video (11 minutes 24 seconds in length). They were free to pause, repeat, or skip sections. After 20 minutes, they completed a questionnaire evaluating the system.
- **MR lesson (20 minutes):** Participants wore a HoloLens 2 connected to an Azure Kinect DK. The instructor was located in a separate room to simulate a remote lesson. Learners observed the instructor’s 3D model in real time and could manipulate it using gestures (rotate, move, flip). The instructor provided minimal verbal feedback, allowing learners to rely primarily on the MR system. After the session, participants completed the same questionnaire as in the video condition.
- **Comparative survey:** After completing both lessons, participants filled out a final questionnaire comparing the MR and video approaches, along with open-ended feedback.

The **lesson content** was predetermined and identical in both conditions. It consisted of the following exercises:

- How to hold the cello
- How to hold the bow
- Playing the cello with the bow
- Finger positioning on the strings
- Practicing scales with pizzicato
- Practicing scales with the bow
- Practicing “*Twinkle, Twinkle, Little Star*” with pizzicato
- Practicing “*Twinkle, Twinkle, Little Star*” with the bow

4.4 Evaluation Method

Three complementary evaluation methods were used to assess the systems:

- **Semantic Differential (SD) questionnaire:** Participants rated their impressions of each lesson using a 7-point scale with opposing adjectives. The items were grouped into three dimensions: *System Usability* (e.g., intuitive–non-intuitive, easy to use–difficult to use), *System Performance* (e.g., efficient–inefficient, clear–unclear), and *Interaction Quality* (e.g., natural–unnatural, interactive–one-sided).
- **Comparative evaluation:** After completing both lessons, participants compared MR and video in terms of clarity for bow grip, fingering, and overall understanding. They also evaluated the visibility of the projected 3D model and the usefulness of manipulation functions (rotation, flipping).
- **Open-ended feedback:** Participants provided qualitative comments on the advantages and limitations of each system, as well as suggestions for improvement. Responses were later coded and analyzed thematically.

5 Result

This section presents the results of the user study, based on both quantitative and qualitative data collected from the participants. The findings are organized into two parts: (1) quantitative results from the Semantic Differential (SD) questionnaire and comparative evaluation, and (2) qualitative insights from open-ended feedback.

5.1 Quantitative Results

The SD questionnaire results are summarized below. Overall, the MR lesson received higher scores than the video lesson in all three evaluation dimensions (System Usability, System Performance, and Interaction Quality).

Figure 4 shows the individual SD questionnaire scores for each participant, with MR results on the left and video results on the right. As can be seen, most participants rated the MR lesson higher than the video lesson across all three evaluation categories. Interestingly, participants 3 and 5, who had no prior experience with musical instruments, gave relatively lower ratings overall, yet even for them, the MR condition tended to outperform the video lesson.

In particular, MR was rated significantly higher in terms of:

- **Clarity of instructional feedback:** Participants reported that observing the instructor’s 3D model made it easier to understand posture, bow grip, and fingering.
- **Naturalness of interaction:** The ability to manipulate the model (rotate, move, flip) helped learners overcome the mirroring and visibility issues that often occur in face-to-face lessons.
- **Motivational aspects:** Several participants rated the MR system as “more engaging” compared with the static video lesson.

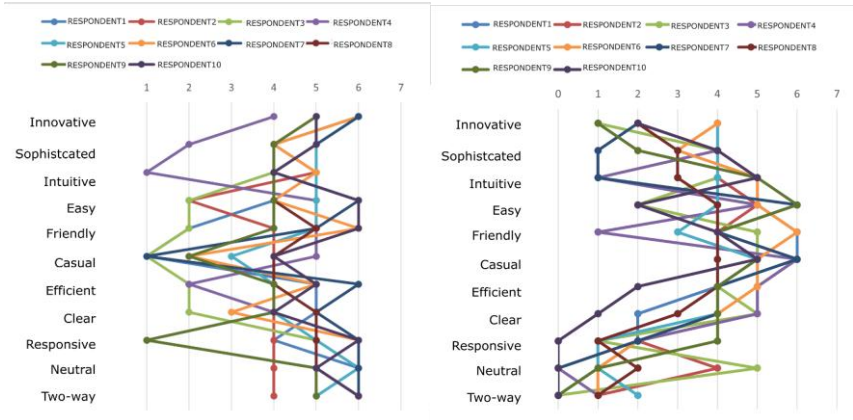


Fig 4. Individual SD questionnaire scores for each participant, showing results for the MR system lesson (left) and the video lesson (right) across the three evaluation dimensions (System Usability, System Performance, and Interaction Quality).

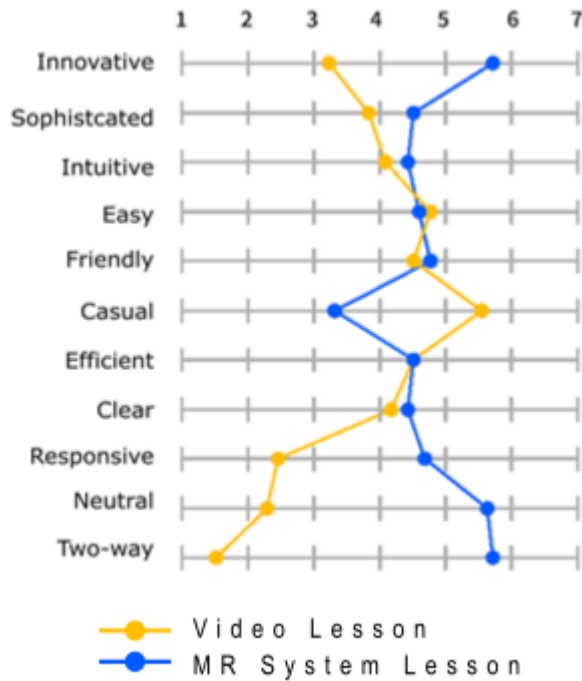


Fig 5. Comparison of average SD questionnaire scores between the MR system lesson and the video lesson.

The comparative evaluation further revealed that MR was generally preferred over video for understanding bow grip and finger positioning. Participants noted that the three-dimensional visualization of the instructor's movements made it easier to grasp subtle details of hand placement and motion. At the same time, video lessons were occasionally considered more convenient for reviewing at one's own pace, since participants could freely skip or replay specific sections when necessary.

Figure 5 shows the average SD scale ratings across all participants. The results clearly demonstrate that the MR system was consistently evaluated more positively than the video-based condition. In this figure, the yellow line represents the average score for the video lessons, while the blue line represents the average score for the MR lessons, illustrating the overall superiority of the MR-based approach in terms of usability, performance, and interaction quality.

5.2 Qualitative Results: Positive Feedback

The open-ended responses revealed several notable strengths of the MR system. Participants particularly emphasized three advantages. First, clarity of instruction: many noted that the 3D visualization of the instructor's model made it easier to understand bow grip and finger positioning compared with the video lesson. Second, enhanced interactivity: the ability to manipulate the model (rotate, move, or flip) was perceived as highly useful for overcoming visibility and orientation issues. Third, motivation and engagement: several participants described practicing in MR as "fun," "novel," and "more engaging" than practicing with video. The sense of presence and real-time interaction contributed to a higher level of immersion in the lesson.

Overall, participants felt that the MR system supported a more intuitive and motivating practice experience.

5.3 Qualitative Results: Areas for Improvement

Despite the positive impressions, participants also identified several challenges and areas for improvement. First, operation difficulties: some learners reported that gesture-based interactions, such as moving or flipping the model, were unintuitive or difficult to perform. Second, visual quality of the model: several participants commented that the projected model appeared somewhat unclear, particularly when observing fine details of hand and finger movements. Third, comparison with video lessons: while MR was generally preferred for learning techniques, participants acknowledged that video lessons offered the advantage of easy repetition and review at one's own pace.

These findings suggest that while MR can provide unique benefits for instrumental practice, improvements in usability and visual fidelity will be essential for broader adoption.

6 Discussion

The findings of this study demonstrate that mixed reality (MR) can provide meaningful advantages for remote music education, particularly in the context of beginner cello practice. Compared with video-based lessons, the MR system offered clearer feedback for bow grip and finger positioning, and participants reported higher engagement and motivation. These results suggest that immersive and interactive technologies can address some of the challenges that have long existed in traditional instrumental pedagogy.

One of the most notable contributions of MR is its ability to overcome visibility and orientation issues. In conventional face-to-face lessons, learners often struggle to correctly perceive fingerings and hand positions due to distance or mirrored perspectives. The ability to freely manipulate a 3D model in MR allowed learners to confirm subtle details that are otherwise difficult to observe. This feature was strongly reflected in the positive feedback and quantitative evaluation.

At the same time, the study revealed limitations that must be addressed. Gesture-based operations were sometimes unintuitive, and the visual fidelity of the 3D model was insufficient for fine-grained observation of finger movements. These technical challenges suggest the need for further refinement, such as improving tracking accuracy, enhancing rendering quality, and offering more user-friendly interaction methods.

A limitation of the present study is the relatively small sample size (10), which was primarily constrained by difficulties in participant acquisition. Also, The current system's reliance on specialized hardware, such as the HoloLens 2 and Azure Kinect, results in a relatively high cost and limited accessibility. Consequently, future development must explore more cost-effective alternatives, including readily available, lower-cost MR headsets and cameras.

Another important consideration is the role of MR in relation to video lessons. While MR excelled in clarity and engagement, participants still valued video lessons for their replayability and convenience. This indicates that MR should not be viewed as a complete replacement for video, but rather as a complementary tool within a blended learning environment. For example, an MR system could be used initially to clearly understand the content of a cello lesson. After grasping the general movements, the student could then switch to video lessons for repeated practice. This illustrates one way the MR system can be utilized.

Finally, this study highlights the potential of MR for broadening access to instrumental instruction. In regions where expert cello teachers are not readily available, MR-based systems could serve as a valuable support mechanism, enabling learners to continue practicing without frustration caused by misperceptions of technique.

Overall, the results demonstrate that MR has significant promise for music education, but also emphasize the importance of addressing technical challenges and exploring hybrid models that combine the strengths of MR and video-based instruction.

7 Conclusion

This study presented the design, implementation, and evaluation of a mixed reality (MR) system for supporting remote cello practice. The system was designed to address specific challenges faced by novice learners, including difficulties in recognizing bow grip, posture, and finger positioning, as well as problems caused by mirrored or obscured views during traditional lessons.

Through a user study with university students, we found that the MR system offered clearer instructional feedback, greater interactivity, and higher engagement compared with conventional video lessons. In particular, the ability to manipulate a 3D model in real time proved valuable for overcoming visibility and orientation issues, which are common obstacles in string instrument pedagogy.

At the same time, the study highlighted areas that require improvement, such as gesture-based interaction and the visual fidelity of the projected model. Furthermore, participants noted that video lessons remain useful for self-paced review, suggesting that MR is best employed as a complementary tool rather than a complete replacement.

Future work will focus on refining the technical aspects of the system, such as improving motion tracking and rendering quality, while also exploring hybrid learning models that combine the strengths of MR and video-based instruction. In addition, expanding the scope of the system to other string instruments and broader educational contexts will further clarify the role of MR in music pedagogy.

Acknowledgments

The authors would like to express sincere gratitude to Dr. Shinji Chiba of Microsoft Japan for providing access to the Holoportation system. Appreciation is also extended to the juniors of the Hokkaido University Symphony Orchestra and the members of our laboratory for their kind cooperation as participants in the experiment.

This work was supported by the New Energy and Industrial Technology Development Organization (NEDO), Project JPNP23025.

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