The Effectiveness of Video Modeling with Video Feedback on a Given Piece for Mid-To-Late Elementary Piano Students

Huiyun Liang

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THE EFFECTIVENESS OF VIDEO MODELING WITH VIDEO FEEDBACK ON A GIVEN PIECE FOR MID-TO-LATE ELEMENTARY PIANO STUDENTS

by

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DEDICATION

To my parents, uncle, and parents-in-law, who always believe in me, respect my choices, and support my study in music unconditionally.

To my husband, Po-Jung, with whom I have overcome many life challenges. His positive attitude always guides me and gives me strength.

To my piano teachers, who have inspired me to dedicate myself to music for the rest of my life.

To my piano students, who motivate me to continue growing.

To my dear friends and colleagues at the University of South Carolina, who always help me and give me advice whenever needed.
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ABSTRACT

The primary purpose of the study was to investigate the effectiveness of video modeling with video feedback for developing mid-to-late elementary piano students’ motor skills in learning the piece “Polka” by Dmitri Kabalevsky. The secondary purpose was to evaluate the benefits of this method for other aspects of performance and performance retention. Five (N=5) piano students, 8 to 9 years old, at mid-to-late elementary level were selected to participate in this study. The results of the study summarized the performance progress of four participants who demonstrated similar levels of technical and reading skills and completed the test requirements.

The full-scale research was carried out in five weeks, including three weekly lessons and two post-tests on the fourth and fifth week respectively. Video modeling was integrated during the lessons by using expert-modeling, self-modeling, and the comparison of the two models. A motion analysis application was used to provide instant video feedback. In addition, video materials were provided for home practice, which included expert-modeling and feedback videos of self-modeling. Each participant’s performance in playing “Polka” hands separately and hands together was tracked by multiple tests during the lessons and two post-tests.

The results of the study showed that incorporating video modeling during the piano lessons effectively improved all targeted motor skills in various levels across participants. Video modeling during the lessons proved to be more effective on the targeted motor skills in one hand than both hands together. The benefits of video
modeling seen in targeted motor skills are also positively reflected in their overall scores in other aspects of performance; however, the improvements in each category of the other aspects, including pitch/rhythm accuracy, balance, dynamics, and artistry, were inconsistent across participants.

The video materials for home practice showed general positive impacts on the targeted performance. Video materials for the hands-together performance during the third week of practice were more beneficial than for single-hand performance during the second week of practice. The final post-test result showed that all participants continuously improved the hands-together performance one week after removing the video materials from the fourth week of practice.
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LIST OF ABBREVIATIONS

bpm ......................................................................... Beats per Measure
H.T. .......................................................................... Hands Together
L.H. ......................................................................... Left Hand
mm. ........................................................................... Measure
R.H. ......................................................................... Right Hand
CHAPTER 1
INTRODUCTION

Social learning theory indicates that learning is more efficient when gained through observation of models; this is how most human behavior is acquired (Bandura 1977). Modeling illustrated by an individual can be live, filmed, or through any other medium; the information is transmitted when another individual observes and then imitates or adapts the model into “thoughts, attitudes, or overt behavior” (Dowrick and Jesdale 1991, 65). Traditional methods of piano instruction largely rely on a teacher’s live modeling and verbal instruction. In a typical piano lesson, a teacher introduces and demonstrates a new skill, and a student replicates it from what they can understand and remember via observation. The teacher provides verbal feedback and demonstration if further improvement is needed. The learning sequence can be described as follows: model (teacher)—copy (student)—feedback, and/or model (teacher)—refine (student). Therefore, the teacher’s modeling and verbal feedback plays an essential role in guiding students to learn a skill via observation.

However, live modeling and verbal feedback cannot be available all the time. Students spend the majority of time practicing on their own. Therefore, the quality of learning a skill is challenged by how well students observe during lessons and how much information they can retain and use for home practice. The effectiveness of learning can also be diminished by students’ capability to evaluate and refine their own performances.
when a teacher’s assistance is not available. It is misguided to require an elementary piano student to have this insight and capability without years of training and experience. Bandura (1986) indicated that in most situations, learners cannot fully observe their behavior, and, as a result, learners may practice the incorrect responses multiple times while assuming that they are following the required actions. This explains why students come back to lessons with new problems and undesirable habits, which will take longer for teachers to correct.

Understanding the fundamental processes of observational learning guides piano teachers to seek feasible solutions to improve the efficiency and quality of learning a skill. Bandura (1977, 1986) proposed a multi-step process of observational learning, including 1) attentional process, 2) retention process, 3) production process, and 4) motivation process. In the attentional process, a certain amount of information is selected and extracted from ongoing-modeled events. During the retention process, if modeled behavior is to have enduring effects on observers, the selected information must be coded into symbolic forms, which serve as internal models to be retained in the memory for future action (Carroll and Bandura 1985). In the production process, symbolic forms are converted into appropriate actions. In the motivation process, learners transmit the modeled behavior into action when positive incentives are provided; for example, if the modeled behavior results in a rewarding outcome. Acquired behavior may not always be performed: “discrepancies between learning and performance are most likely to arise when acquired behavior has little functional value or carries high risk of punishment” (Bandura 1986, 68). Based on Bandura’s four sub-processes of observational learning, live modeling serves as essential visual stimuli activating the entire learning process.
under traditional instruction, while verbal instruction can direct students’ attention to relevant information of the modeled behavior, as well as facilitating the encoding of information through concrete language and encouraging motor reproduction. Moreover, verbal feedback evaluates students’ performances and guides them to focus on the specific aspect that they need to improve during the next observation. Students may need to go through these four sub-processes of observational learning multiple times until a skill is well established.

Fortunately, with the increasing accessibility of video technology, students do not have to rely on single-view observation. They can access the recorded modeling easily and observe without limitations of time and space. Cameras can be additional eyes, capturing the information that is easily overlooked during observation. Video modeling becomes a new instructional trend, during which learners observe a video recorded demonstration and utilize the information acquired from the video to imitate, modify, and improve targeted skills or behaviors. According to Dowrick and Jesdale (1991), video modeling has been well established in six broad categories, including professional training, social skills and daily living, parent training and child self-management, preparation for treatment, motor performance, and special populations (68). The term has been used in numerous ways. It is “a powerful intervention in its own right...[and] generally used in conjunction with other procedure” (Dowrick and Jesdale 1991, 75). Corbett and Abdullah define video modeling as “a well-validated intervention documented in the behavioral science” (2005, 2); and Schoonover et al. described it as “simulated presentations in videotapes and films as teaching aids” (1983, 804). Alternative terms of video modeling include “film”, “television”, or “videotape”
modeling, which could be found in the studies of Thelen et al. (1979), Schoonover et al. (1983), Wilmer (1967), and Friedrich and Stein (1975).

Video modeling displays several advantages over live modeling. For instance, video modeling can “[incorporate] multiple models and [focus] selective attention by use of the camera and other technical advantages” (Dowrick and Jesdale 1991, 76). Studies show video modeling is particularly beneficial for autistic learners because modeling presented on the screen restricts the field of focus, guiding observers’ attention to the relevant visual and auditory stimuli (Corbett and Abdullah 2005). Video modeling can be used as an effective pedagogical tool for video feedback (Amara et al. 2005; Baudry, Leroy, and Chollet 2006; Boyer et al. 2009; Palao et al. 2015). Learners’ performances can be captured by video cameras and replayed on the computer or other devices for motion analysis. This process provides video feedback, allowing learners and their teachers to observe and analyze the learner’s performances in comparison to expert’s performances. Video modeling can also reinforce visual learning, facilitate retention of information, increase motivation, and enhance students’ engagement (Weir and Connor 2009). Moreover, the development of digital technology and the internet allow recorded models to reach a broad range of populations almost immediately, and learners can learn a skill at their own pace.

Exploring how video modeling has been used to improve motor performance in sports, physical education, and other physical training programs might suggest new possibilities for piano teachers in resolving issues involving advanced motor skills. Studies have shown that video technology has brought the most significant change in sports over the past century, allowing athletes to achieve better records in speed or height
while maintaining physical health and wellness (Palao et al. 2015). This new method is not only important for professional athletes to improve efficiency and precision of motor performance, but also facilitates beginning and inexperienced learners’ acquisition of motor skills. These significant effects have been shown in numerous studies in sports, physical education, and other physical training programs (Amara et al. 2015; Baudry, Leroy, and Chollet 2006; Boschker and Bakker 2002; Boyer et al. 2009; Palao et al. 2015; Reo and Mercer 2004; Zetou et al. 2002). Similar to sports, piano playing has high demands for physical movement. The efficiency of physical movement is the key for pianists to overcome technical challenges and generate desired performance outcomes. After establishing the purpose of the study and need for the study, the limitations of the study and research questions are stated. The literature review section overviews the supporting research and theory in video modeling.

**Purpose of the Study**

The primary purpose of the study was to investigate the effectiveness of video modeling with video feedback for developing mid-to-late elementary piano students’ motor skills in learning a given piece. The four sub-processes of observational learning by Bandura and Jeffery (1973) indicate that motor skill learning involves cognitive acquisition prior to physical performance. The research investigated whether students can perceive accurate information of movement patterns through video modeling with video feedback, and transfer acquired visual information into precise physical actions. The secondary purpose was to evaluate if video modeling with video feedback would benefit students’ other aspects of performance, including pitch/rhythm accuracy, dynamics,
balance, and artistry. Finally, the researcher investigated the retention of students’ motor performance and other aspects of performance one week after removing video modeling with video feedback from home practice.

Need for the Study

Modeling has been valued as “one of the most powerful means of transmitting values, attitudes, and patterns of thought and behavior” (Bandura 1986, 47). In the modern era, technological advancement has created a variety of possibilities of learning. Information acquisition via live instruction or printed materials is not the only option. Video modeling has been widely used in many fields for multiple purposes, such as training in a professional or social skill, preparing patients emotionally for medical treatments, developing young children’s social behavior, enhancing learning outcomes for autistic learners, maximizing athletes’ motor performance, etc. In the field of sports and physical education, methods and technologies of video modeling have been fully exploited with the primary focus on improving precision and efficiency of motor performance.

The development of efficient motor skills is essential for every piano learner. Alban Kit Bridges stated, “[piano] playing is a motor skill. If this fact is lost, pianists lose an important perspective for solving pianistic difficulties” (Bridges 1985, 84). He further elaborated that developing efficient motor skill allows “ease of execution and the greatest potential for creativity in interpretation” (84). Reginald Gerig considered that “thorough development of the basic physical tools has been of the most vital concern to keyboard performers and pedagogues across the centuries” (Gerig 2007, 1).
Piano pedagogues have never ceased exploring the development of the physical capability and the possibilities of piano playing. This can be traced back to as early as the beginning of the seventeenth century. According to Stewart Gordon (2000), the first important pedagogical treatise was *Il Transilvano* written by Girolamo Diruta. This treatise included instructions for hand positions and suggested use of the arm to guide hand movements (Gordon 2000). Since then, numerous instructional materials have appeared, addressing various issues regarding piano techniques and physical movements. For example, C.P.E Bach’s *Versuch über die wahre Art das Clavier zu spielen* (*Essay on the True Art of Playing Keyboard Instruments*) discussed basic posture, left hand independence and flexibility, and fingering (Gordon 2000). Technic exercises, such as Carl Czerny’s *Practical Exercises for Beginners*, Op. 599 (1886), first published in 1839, and *The School of Velocity*, Op. 299 (1893), first published in 1833, and Charles Hanon’s *The Virtuoso Pianist in Sixty Exercises* (1886), first published in 1873, are still prevalently used today for developing finger strength, dexterity, and independence, as well as hand coordination and movements.

From the late nineteenth century to the early twentieth century, scientific developments brought new perspectives for piano pedagogues and they began to explore the physics of mechanics, anatomy, psychology, and neurophysiology as they related to piano playing (Gordon 2000). German piano pedagogue Rudolf Maria Breithaupt’s major publication *Die Natürliche Klaviertechnik* (Natural Piano-Technic) is the representation of the weight school, which consists of three volumes. The second volume has been translated into English, entitled *School of Weight-Touch: A Practical Preliminary School of Technic Teaching the Natural Manner of Playing by Utilizing the Weight of the Arm*
This book includes numerous text descriptions with photographic illustrations to address hand position, arm movements, finger actions and various motions based on the principles of weight technique, freedom and relaxation.

In contemporary American piano method books, many authors devote a major portion exclusively to technical development. For example, Nancy and Randall Faber’s (1995-2015) Piano Adventures and Alfred Music’s (Alexander et al. 2005-2016) Premier Piano Course include technique books for each level that aim to prepare students for the corresponding pieces in the lesson or performance books by improving the necessary skills. To facilitate understanding of specific movement patterns, many technical exercises are accompanied by symbolic representation or verbal description of the movement patterns.

Even with the assistance of abundant pedagogical resources, the researcher as a piano teacher still encounters situations where young students cannot imitate the movement patterns accurately after multiple viewings of live demonstrations, or students can execute a movement pattern correctly in the lesson but come back with unexpected movement errors in the next lesson. To explain the latter situation, Puopolo (1971) indicated that instrumental students spent the majority (90%) of their entire study time on their own while the students only spent 10% of time in lessons with their teachers. Without teachers’ assistance during home practice, students may practice incorrectly and inefficiently, or may not know how to correctly address a particular problem. Therefore, undesirable habits may form, and that may take longer for teachers to correct during limited lesson time.
How do we explain the former situation where students fail to transfer what they have seen from live demonstrations to actual actions? Motor skill learning is “the acquisition of a complex movement sequence” (Luft and Buitrago 2005, 205). Based on Bandura’s four sub-processes of observational learning and the nature of the complexity of motor skills required for playing piano, students may not have the capability to perceive a series of movement patterns accurately during the attentional phase, or they may not be able to transfer what they have seen into a proper symbolic form during the retention phase for further action. In both situations, video technology creates opportunities for learners to replay the modeling as many times as needed, to analyze and comprehend specific movement patterns through slow-motion replay, and to evaluate their own performance and correct errors through comparison with the targeted performance.

The benefit of using video modeling as a visual guide for learning piano has been recognized since the second half of twentieth century with the development of video technology. Seymour Bernstein’s videotape “You and the Piano” (Mathews 1986) provided clear visual demonstration of fundamental finger, hand, and forearm movements as well as how to approach basic exercises and standard piano literature by using proper gestures. During the demonstration, the camera captured a close-up view of his hands. Bernstein demonstrated each movement slowly with detailed verbal explanation of the physical mechanism. The experiments of teaching piano via television appeared around the 1970s and 1980s (Erlings 1970; Fore 1976; Mach 1978; Giles 1981). Researchers intended to provide qualitative and effective instruction through television broadcast to reach a larger population of piano learners.
Stepping into the digital age of the twenty-first century, countless educational video products for piano study are available in the market. Fred Karpoff’s (2018) *Entrada Piano Technique* provides extensive online video resources that address comprehensive piano techniques through detailed instruction and multi-dimensional analysis of movements. However, in comparison to the wide use of video modeling in various forms in sports and physical education, video modeling is still a new territory for piano teachers. Technology allows instant replay, motion analysis and immediate sharing of modeled and learners’ performances. This creates vast possibilities of using technology in education. The above facts suggest the need to investigate the effectiveness of incorporating video modeling into a traditional piano learning sequence to maximize students’ motor performance, and eventually benefit their overall musical understanding and performance.

**Limitations of the Study**

The study was limited to an examination of the effectiveness of incorporating video modeling with video feedback on a given piece for mid-to-late elementary piano students. Video modeling with video feedback was incorporated into a traditional instructional sequence of piano lessons. The researcher intended to use this new method as a supplementary tool to enhance the efficiency of learning during students’ regular lessons and practice sessions, but not use it to replace the live instruction of piano study. In addition, the primary focus of utilizing this new method was on movement analysis for specific motor skills in piano playing.

The study applied the single-subject experimental design, a method that focuses on the behavior change of an individual after some treatments and involved a small
sample size. Five mid-to-late elementary piano students enrolled in the Center for Piano Studies at the University of South Carolina were selected to participate in this study. The research was limited to the span of five weeks. The researcher provided three consecutive lessons during the first three weeks and two post-tests during the fourth and fifth week. Moreover, the study was limited to track five participants’ progress on learning one given piece at the mid-to-late elementary level; therefore, only the techniques that were required in this piece were addressed in this research study.

**Research Questions**

The following research questions guided this study:

1. Is there a significant improvement in executing a targeted motor skill after the treatment (video modeling with video feedback) is introduced?
2. Is there a significant improvement in demonstrating other aspects of performance, including pitch/rhythm accuracy, dynamics, balance, and artistry, after the treatment is introduced?
3. Does the improvement show in all targeted motor skills or other aspects (those listed above) of performance after the treatment is introduced?
4. Is there a significant improvement when video modeling with video feedback is available during home practice?
5. Can students retain their motor performance and other aspects of performance one week after removing video modeling with video feedback from home practice?
Review of Literature

According to Dowrick and Jesdale (1991, 68), video modeling has been well established in six broad categories, including “professional training, social skills, children and parents, preparation for treatment, motor performance, and special populations” and this new instructional mode shows considerable potential to be continuously explored in many other fields. This study aims to explore the possibilities and effectiveness of using video modeling as an instructional tool to develop mid-to-late elementary piano students’ motor skills on a given piece. The first section of the literature review will discuss how video modeling has been used to facilitate motor learning outside the field of music learning. The second section will explore current literature that has applied audio or video modeling in music instruction. The last section will discuss Bandura’s social learning theory and observational learning, which will serve as the primary guidance for the experimental design of this study.

Video Modeling in Motor Learning (Non-Music)

Numerous studies in the fields of sports, physical education, and physical therapy demonstrate video modeling is an effective instructional medium to facilitate observers’ learning of a motor skill (Amara et al. 2015; Baudry, Leroy, and Chollet 2006; Boschker and Bakker 2002; Boyer et al. 2009; Palao et al. 2015; Roe and Mercer 2004; Zetou et al. 2002). Motor skills can be acquired from observing video modeling, and this generates equal or better performance outcomes compared to traditional instructional methods, such as live modeling with verbal feedback, or written instruction (Amara et al. 2015; Reo and Mercer 2004).
Reo and Mercer (2004) investigated the effects of different modes of instruction on an upper-extremity exercise program for physical therapy. Forty-three (N=43) non-injured volunteers were randomly divided into four types of instruction, including 1) live modeling, 2) videotaped modeling with the demonstration of errors and correction, 3) videotaped modeling in an error-free demonstration, and 4) written instruction. Live and videotaped models were demonstrated by a skilled and professional physical therapist. Participants’ performance accuracy was tested immediately after the instruction and practice period, and retention of the instructed skills was tested after a one-day delay. The results showed that the groups participating in live modeling and videotaped modeling instruction achieved higher performance accuracy than the written instruction group. Although participants in the live instruction group had the advantage of receiving individualized verbal feedback about their errors during the performance, this instruction did not result in a better performance than the corrected-error or error-free videotaped modeling as the researchers expected. The researchers suggested that videotaped instruction could be an alternative method to live instruction in clinics or hospitals. Videotaped instruction can be a “cost effective” and “time efficient” method that instructs large numbers of patients while maintaining a “high-quality of patient care” (623).

Amara et al. (2015) conducted a comparative study between traditional learning methods based on verbal feedback, and a new technology method based on video modeling and motion analysis. This study investigated the differences between two pedagogical methods in teaching physical education students how to effectively navigate and clear hurdle races. The traditional instruction included live demonstration, verbal feedback, technical errors and corrections, and knowledge of hurdle clearance. Video
modeling consisted of the use of “video feedback with self-modeling, expert-modeling and model’s superposition to correct technical faults” (Amara 2015, 228). Model’s superposition is a method of analyzing motions between self-modeling and expert-modeling simultaneously. Dartfish¹ software enables two modeling videos displayed side by side at the same time. Twenty-seven (N=27) sports science students were divided into two groups: a modeling group and a traditional group. The results showed that both groups improved their performance; however, the modeling group demonstrated a 26.88% increase in the mean technique score over the traditional group. In addition, video feedback with model’s superposition provided “educators with pedagogical tools to promote a deeper understanding of the human movement, its relationship with athletic performance and practical application of ideas and knowledge” (Amara 2015, 230).

Amara et al. (2015) categorized three forms of video modeling² that have been commonly used in physical education: 1) self-modeling, 2) expert-modeling, and 3) model’s superposition. The effectiveness of each form has been evaluated in varied formats through comparison between and with other instructional modes (live or written instruction), or in combination with additional aids, such as verbal feedback or motion analysis.

The following studies compared the effectiveness of video modeling by experts to the modeling by novices or self-modeling. Boschker and Bakker (2002) examined

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¹ Dartfish, based in Switzerland, is performance analysis software that has been widely used in sports, education and healthcare environments. “Dartfish develops and offers cutting-edge video solutions that empower its users to capture, analyze and share video content,” http://www.dartfish.com/About (accessed September 19, 2017).

² In Amara et al.’s (2015) study, the purpose of using video modeling was to provide video feedback through receiving self-modeling, expert-modeling, and model’s superposition.
whether inexperienced sports climbers could learn new possibilities of actions through observing expert video modeling, in comparison with observing novice video modeling, or video of a climbing wall without a model. Twenty-four (N=24) inexperienced male participants were divided into these three groups. In the videos, expert climbers utilized a more complex climbing action (arm crossing), which required knowledge of the climbing route, while novice climbers utilized a simpler action (dual grasping). The result of this study showed that the inexperienced climbers who watched the expert performance showed a preference for using more advanced climbing technique (arm crossing) and demonstrated more efficient climbing movement patterns. The inexperienced climbers who observed the novice performance or did not observe a model, commonly used a simpler technique (dual grasping). Although novice climbers’ performance skills might be enhanced with increased time of practice and experience, observing expert’s modeling through videos allowed them to achieve their learning outcome with less practice time.

Zetou et al. (2002) conducted a comparative study of the influence of expert video modeling and self-video modeling on the performance of two volleyball skills (set and serve). Both types of modeling included verbal cues as previous studies demonstrated positive effects in combining verbal cues and modeling. One hundred and sixteen (N=116) elementary students, 12 years old, were randomly divided into two groups. Students in the expert-modeling group watched the demonstration by an elite male and a female volleyball player who won the 1996 Olympic games. They watched the video at the beginning and in the middle of their practice while the teacher provided verbal instructional cues about the important factors of the skills. Students in the self-modeling group watched their own performance from the videotape twice while the teacher
provided verbal cues to correct errors. The result showed that both groups improved their new skills. However, participants in the expert-modeling group performed better on the set and serve skills than the participants in the self-modeling group.

The quoted studies showed that expert-modeling had a more significant effect on beginning learners than novice modeling or self-modeling through videos. Zetou et al. (2002) provided several possible explanations for the students in the expert-modeling group outperforming the students in the self-modeling group. First, expert-modeling set a higher standard and achievement goal for the observers. Second, participants might improve their self-efficacy through observing expert-modeling. Third, experts provided more accurate information of a skill while self-modeling presented a less perfect execution. Fourth, instructional cues provided in the expert-modeling group allowed the participants to focus on their execution of the skill. Although the verbal cues for correction of errors were provided in the self-modeling group, it was difficult for children to focus on correcting errors and improving their performance at the same time. Fifth, expert-modeling visually assisted participants in developing appropriate coordination patterns for body movements. Self-modeling is possibly more effective for skilled athletes because they have more knowledge for recognizing and correcting errors.

Although novice learners are less likely to perceive goal performance and perfect execution from self-modeling videos, learners could still benefit from observing their own performance with effective and prompt feedback. Palao et al. (2015) assessed the effectiveness of self-modeling through video feedback on student navigation of hurdle races in a track and field unit. Sixty students (N=60) from three classes in one Spanish high school participated in the study and had been assigned to different feedback
conditions. A licensed and experienced teacher taught these three classes. All the classes were structured the same, including 1) warm-up, 2) initial information about objectives, tasks, and the key technical aspects, 3) the main part of the lesson, and 4) a lesson summary by the teacher. During the main part of the lesson, students were assigned to three groups and rotated at eight-minute intervals through three stations. The instructional conditions in the first two stations remained the same: students practiced the hurdle skills with verbal teacher feedback. The researchers assigned three different conditions at the third station: 1) verbal feedback by the teacher, 2) video and teacher feedback, and 3) video and student feedback. Teachers or students used the software Dartfish to capture their performance through video and to review at a later time. The results showed that both “verbal feedback by the teacher” and “video and teacher feedback” resulted in a significant improvement in technique and knowledge learning; however, the students who only received verbal feedback from the teacher showed a lower quality and quantity of practice in classes. The students in both “video and teacher feedback,” and “video and student feedback” conditions displayed the highest level of practice in classes, while students’ skill execution was improved the most through teacher-led video feedback. In comparison with the outcome of teacher’s feedback and students’ feedback, students gained greater knowledge with teacher’s feedback even though they received a greater amount of feedback from their peers. The result indicated that teachers had more knowledge to identify errors and were able to provide better quality of feedback. Conversely, students had more active engagement when they received feedback from peers, resulting in better task execution. Palao’s study not only showed the positive result of video modeling on motor skill attainment, but also indicated that prompt feedback
during video observation might aid students’ learning. It may be valuable to train students how to correctly identify errors from observing their own performance, thereby improving their quality of feedback and maximizing their learning outcome without a teacher’s presence.

The studies that integrated model’s superposition effectively enhanced learners’ motor skills (Amara et al. 2015; Baudry, Leroy, and Chollet 2006; Boyer et al. 2009). This method “[facilitates] the recognition of essential differences between the two performances,” thus providing learners with “qualitative and meaningful visual feedback” (Baudry, Leroy, and Chollet 2006, 1056).

Boyer et al.’s study (2009) examined the effectiveness of combining video modeling by experts and video feedback from participant’s own gymnastic performance (self-modeling). The performance skills of four (N=4) female competitive gymnasts, 7-10 years old, were evaluated in a multiple baseline design. The experiment procedure included baseline, intervention, and follow-up assessment. The gymnasts practiced the targeted skills and received coaching and verbal feedback under normal conditions where the baseline data were collected. In the intervention session, they were asked to view and compare expert video modeling and their own performance for the same skill side by side on the computer. No verbal feedback was provided during this time. The coach continued the practice and used verbal feedback after this intervention. Their performance skills were later assessed through weekly follow-up sessions without video modeling and video feedback. The researchers concluded that the gymnasts’ performance skills improved more quickly by being exposed to this intervention than regular practice and coaching.
The follow-up assessment showed that the gymnasts maintained a higher level of performance when video modeling was no longer used.

Baudry, Leroy, and Chollet’s study (2006) is another example of model’s superposition. This study investigated the effect of combined expert-modeling and self-modeling along with a quantitative performance analysis on gymnasts’ performance of the double leg circle movement on a pommel horse. This motor skill requires “a series of complex movements in which both effectiveness and aesthetics are extremely important” (Baudry, Leroy, and Chollet 2006, 1056). Sixteen (N=16) gymnasts who had at least six years of competition experience were randomly divided into two groups: a control group without video feedback and a modeling group. In the modeling group, the gymnasts observed their own performance and expert performance simultaneously from the computer. The researchers indicated that many previous studies that used combined expert and self-modeling did not have a positive effect on motor learning due to a lack of additional instruction. Therefore, in this study, a coach provided a quantitative performance analysis that could direct gymnasts attention to the relevant aspects of the skills. The result showed that “the modeling group improved their body segmental alignment more than the control group” (1055).

Baudry, Leroy, and Chollet explained the advantages of combining expert-modeling, self-modeling, and quantitative performance analysis on motor learning. According to social cognitive theory and what the study revealed, the researchers concluded that expert-modeling provided correct information about how to perform a skill successfully, which was “extracted” and “transformed into a cognitive representation” and this “appropriate motor commands... [enabled] the learner to
approximate the skill that [had] been observed” (Baudry, Leroy, and Chollet 2006, 1060). Furthermore, the better the model used, the more effectively the learners would imitate. On the other hand, self-modeling provides “a realistic view” of the learners performing a skill, and establishes “a direct link” between modeled performance and their own performance (1060). In addition, the researchers pointed out an interesting finding that no significant progress was observed when no feedback was given to the gymnasts during pre-test and post-test for the control group and during post-test and retention test for the modeling group. This might explain the value of using quantitative performance analysis in the modeling group. The feedback gained from this analysis could guide gymnasts’ attention to a specific aspect of the motor skills, thereby facilitating a deeper understanding of the difference between the modeled performance and their own performance.

There are more benefits of using this advanced technology in facilitating the process of motor learning. The advanced technology in digital video enables observers to perceive a series of action patterns through slow motion and to observe it as many times as desired. In Boschker and Bakker’s study (2002), observers watched the videos four times before climbing: two times in slow motion and two times at normal speed. The whole observation-and-practice process was repeated four times. This reinforced the visual representation of a motion pattern to be retained in memory. Also, learners could learn a motor skill at their own pace without external pressure.

Weir and Connor (2009) investigated the role of digital video in physical education in twelve Irish schools and showed the value of using video modeling as an aid for feedback, assessment, and self-evaluation, as well as in increasing student motivation,
learning outcomes, concentration, and engagement. These videos also created a collection of resource and reference materials that teachers could use in their teaching. However, they also cautioned that “it [was] not simply something that [could] be applied to conventional teaching strategies without careful planning and preparation on the part of the teacher” (165). Therefore the design of this study has been carefully planned for preparation time, the video content, accessibility to new technology, and the cost of apparatus.

These studies in the fields of sports, physical education, and other physical training programs show a great potential in the use of video modeling—expert-modeling, self-modeling, or a combination of both—in training a specific motor skill. These three types of modeling can provide clear visual information of movement patterns and immediate visual feedback for learners as they practice a certain skill. Technology development has created vast possibilities for teachers and learners to use videos in the ways they desire. Meanwhile, careful planning of incorporating new technology into traditional educational setting is needed to generate desirable learning outcomes.

*Taped Modeling in Music Instruction*

The benefit of using taped modeling in music education has been investigated in the forms of audiotaped modeling (Anderson 1981; Hewitt 2001; Morrison, Montemayor, and Wiltshire 2004; Peightel 1971; Puopolo 1971; Rosenthal 1984; Sang 1987; Zurcher 1972) and videotaped modeling (Fleming 1977; Jordan 1980; Linklater 1997; Quindag; 1992; Tjornehoj 2001). Although the findings of most studies concur with Dickey’s (1992) conclusion that “the use of a prepared tape as a model appears to be an effective teaching strategy for both elementary students and college students” (36), there is still
inconclusive effectiveness of using taped models to improve musicians’ performance 
(Hewitt 2001; Linklater 1997; Quindag 1992). No significant benefit of using audiotaped 
models has been found, for instance, in Hodges’ study (1974) and Anderson’s study 
(1981), which calls attention to the need for further investigation in this field. The 
widespread accessibility of video technology can provide both visual and aural models, 
which offer extended possibilities for music learning (Linklater, 1997).

Many studies explored the possibilities of using taped models as an instructional 
ad during students’ individual practice (Anderson 1981; Linklater 1997; Puopolo 1971, 
Zurcher 1972). Puopolo (1971) suggested that instrumental students spent a small portion 
(10%) of their entire instrumental study time with their teachers, either in a private lesson 
or a class, to learn new concepts and receive comments, while for the majority (90 
percent) of their study time, they work on their own, teaching themselves the 
performance skills and developing needed motor patterns that enable them to execute the 
acquired concepts. Therefore, without further assistance from their teachers during home 
practice sessions, students may practice incorrectly, utilize incorrect information, or not 
know how to address a particular problem (Puopolo 1971; Anderson 1981). Taped 
materials may provide additional guidelines for students during their practice.

Puopolo (1971) created self-instructional practice materials on recorded tape for 
beginning instrumentalists. In this study, fifty-two (N=52) fifth grade trumpet and cornet 
students from six elementary school were divided into two groups. The experimental 
group used recorded tape during practice while the control group practiced the same 
material without tapes. The recorded tape was based on each weekly lesson, including 
model performance and simple piano accompaniment for all materials, as well as verbal
instruction, explanations, and counting of meter from a slow to final tempo. The students listened to the recording while reading the score, playing each segment, and then listening to the reinforcements (model performance) for comparison with their own responses. The practice sessions were held at school for ten weeks. In addition, participants were tested before the study in the following three aspects: 1) music achievement, 2) social status, and 3) I.Q. music achievement. The researcher used the Watkins-Farnum Performance Scale in the post-test to measure performance achievement. The result of the study showed that participants in the experimental group improved significantly in performance achievement as compared to the control group. Another finding was that “students below average in I.Q. or music achievement can do comparatively as well in performance achievement as those above average” (348).

Zurcher’s (1972) study compared the effect of model-supportive practice with the traditional practice on performance achievement, including “gross pitch discrimination, tempo stability, pitch matching, fingering, or slide position errors, rhythm errors, and total practice time per week” (5). Different from Puopolo’s study (1971), the practice session of Zurcher’s study was held in a home practice environment. Forty-three (N=43) fourth to sixth grade brass instrument students were randomly assigned into an experimental group and a control group for the first week of practice. The groups rotated the treatment each week. The results showed that model-supportive practice is more effective than traditional practice in reducing pitch errors and rhythm errors, developing pitch matching skills, and increasing the amount of practice time; however, there is no difference in establishing tempo stability and reducing the number of fingering or slide
position errors. Another finding was that the model-supportive practice increased the “on task” practice thereby improving students’ performance achievement.

Anderson (1981) investigated the effect of using audiotaped modeling for home practice on selected sight-reading and performance skills of sixth-grade clarinet students. Eighty (N=80) students from two sixth-grade centers were randomly selected for the experiment group and the control group. During the eight-week treatment, both groups rehearsed the assigned pieces during the woodwind classes at school. Students in the experimental group received a cassette tape that included an assigned solo clarinet performance recording as well as a tuning note of concert B-flat prior to each exercise. Both the pre-test and post-test used the Watkins-Farnum Performance Scales to measure the four selected sight-reading skills, and a “Practiced Performance Evaluation Test” was given in the final week to measure students’ four performance skills. The result of the study indicated no significant difference between these two groups on any of the selected sight-reading and performance skills. This study might indicate that an audiotaped model alone, without additional aid or treatment, may not be sufficient to improve students’ music performance.

Hewitt (2001) investigated the effect of modeling in combination with other elements of learning, including self-evaluation and self-listening, on junior high instrumentalists’ music performance and practice attitude. Eighty (N=80) woodwind, brass, and percussion students from eighth and ninth grade were randomly divided into eight treatment groups. Each treatment group selected one condition from each category: model or no model, self-listening or no self-listening, and self-evaluation or no self-evaluation. For example, group A is model with self-listening and self-evaluation; group
B is model with self-listening but without self-evaluation, etc. Therefore, eight groups were formed. The audiotaped models were recorded by university music majors and extensive time was taken to ensure the quality of the model performance. Students receiving the self-listening treatment recorded and received a new tape of their uploaded performance each week. For self-evaluation, students were trained to use the Woodwind Brass Solo Evaluation Form (WBSEF). There were several significant findings in this study. First, the aural model had positive impact on learning an unfamiliar piece and increased students’ performance in the subareas of tone, technique/articulation, rhythmic accuracy, tempo, interpretation, and overall performance, although no affects were noticed in the subareas of intonation and melodic accuracy. Second, modeling in combination with self-evaluation gave rise to significant interaction effects in the subareas of tone, melodic accuracy, rhythmic accuracy, interpretation, and overall performance; however, self-evaluation alone (without modeling) did not improve students’ music performance. Third, no direct and positive statistical indications were found between self-listening and music performance. The researcher explained that the disassociation between the capability of detecting errors through listening and the ability to find solutions to correct those errors might be the cause.

The above studies dealt with the learning of band instruments. The participants were beginners or novice learners ranging from fourth to ninth graders. In schools, students were most likely learning the instruments in group class settings. Teachers might not have time or have the necessary skills to demonstrate every instrument in the class (Linklater 1997). Audiotaped modeling with additional treatments, such as programmed materials, verbal instructions, feedback, or self-evaluation, showed the greatest potential
to improve students’ efficiency of individual practice and performance achievement. However, none of the studies above addressed specific motor skills that are needed to play an instrument, although Zurcher’s (1972) study included fingering and slide position errors as part of performance achievement assessment. The result of no difference in reducing the number of fingering or slide position errors might indicate the inefficiency of using aural models in guiding physical movements for beginning instrumental learners.

The following two studies compared audiotaped (aural) and videotaped (visual) modeling for band instrumental beginners, but gave rise to different results. Quindag (1992) investigated the effectiveness of three practice conditions for beginning string students: 1) guided aural modeling, 2) guided aural-visual modeling, and 3) practice only without modeling. Two phases of the study were conducted. During phase I, modeling tapes for violin and an adjudication form and procedure were created. A pilot study was conducted to refine the tapes and a trial evaluation session was conducted to refine the form and procedure. The investigator chose a traditional string method and divided it into 13 segments with each segment introducing a new performance behavior. An instructional script was created for each segment, which included the verbal explanation of each new behavior and verbal reinforcement for “correct posture, instrumental placement, tone production and intonation” (32). The guided aural-visual modeling was recorded by a professional violinist and a narrator under a professional setting. The visual aspect of the modeling included “the performer’s full profile” and “selected close-up segments of posture, hand positions, [and] bowings” (33). The audiotaped modeling was dubbed from the videotape. The adjudication form included aural measurement and
visual/physical measure. After the pilot study, the investigator made some adjustments for the adjudication and procedure.

Phase II was the main study that included three practice conditions. Twenty-three ($N=23$) fourth to sixth grade beginning string (violin, viola, cello, and double bass) students who did not participate in the pilot study were randomly assigned into these three groups regardless of instrumentation. After the ten-week treatment, each student performed “Yankee Doodle” as the post-test. The adjudicators evaluated two aspects of performance: 1) aural performance, and 2) visual/physical performance. A final revised adjudication form was used. However, the result showed no significant effect on performance achievement among guided aural modeling, aural-visual modeling, and no modeling conditions. In addition, “no significant relationships were found between performance achievement and subjects’ grade level, instrumentation, and learning modality” (77). As the researcher explained, the length of the treatment period might be not sufficient enough to maximize the experimental condition, and less practice time of students in group I and II compared to group III might be the cause. In addition, other factors during students’ practice at home, such as the way to use the videotape and the level of attention to the presented materials, were not possible to control.

Linklater’s (1997) study is another example of incorporating videotaped modeling into band instrument instruction. The researcher compared the effectiveness of aural or visual musical models for enhancing students’ music learning and performance. One hundred and forty-six ($N=146$) fifth and sixth grade clarinet beginners from eight schools were randomly assigned to three groups: 1) modeling-videotape group, 2) modeling-audiotape group, and 3) nonmodeling-audiotape group. All three groups used the
textbook that contained numerous photographs of exemplary performance practice. Students in the videotape group received television images as additional visual information. The images were demonstrated by middle-school students and included examples of “exemplary posture, breathing, embouchure, hand position, and instrument potion” (406). In addition, students in both modeling-videotape and modeling-audiotape groups received aural clarinet models and instrumental accompaniment that were performed by professional musicians, while students in the nonmodeling-audiotape group received an audiotape that only included instrumental accompaniment without aural clarinet models. Performance achievement was measured by the Instrumental Performance Test (IPT), which was designed by the researcher. Both visual/physical and aural/musical criteria were evaluated. The result showed that the modeling-videotape group had the highest IPT mean scores, followed by the modeling-audiotape group, while the nonmodeling-audiotape group had the lowest mean scores. In terms of parental involvement, parents in the videotape group felt more comfortable in assisting their children in visual/physical performance abilities, which potentially promoted their children’s performance achievement. Another finding was that students with higher musical aptitude benefited from audio or video modeling tapes more than students with lesser musical aptitude. This might indicate students with higher musical aptitude were able to perform with the tapes more easily and had better discrimination skills to compare their performance with the models (Linklater, 1997).

Evidence of using videotaped recorders for self-evaluation to improve specific motor skills has been found in the conducting field. Fleming (1977) stated: “the act of conducting is a motor skill. If communication is to be achieved, a precise system of
physical movements must be developed” (1). She indicated that: “the goal of any conducting curriculum is not to produce merely skilled executors of a wide variety of mechanical gestures, but rather to help develop musicians who can shape sound into music. The conducting gesture is a means to that end” (6). To achieve this goal, she pointed out several crucial aspects, including the model demonstration from teachers, practice (private self-study sessions), and feedback and self-evaluation.

Fleming reviewed several studies prior to her study in 1977 that used videotape recordings in teaching conducting skills and found disappointing results. She indicated three factors that might determine the effectiveness of a study: 1) time factors—the amount and the length of time that videotaped modeling was used might affect the result; 2) provision of practice—actual practice of component actions has not been designed into many previous studies; 3) structure that includes specific goals of the activities—a planned and structured analysis and observations of behavior is the necessity.

In this study, Fleming combined guided practice materials with the videotape recorder to evaluate the development of choral conducting skills for college students who enrolled in beginning choral conducting classes. The design of the guided practice materials allowed students to focus on “solving a specific conducting problem,” thereby encouraging “the acquisition of a specified body of skills” (31). Twenty-two (N=22) music major students enrolled in the first quarter of the choral conducting sequence participated in this study and no student received previous conducting training. The Conductor Evaluation Form was used as a basis for assessing the physical aspects of their conducting. Thirty-two items based on eight central categories were listed on the evaluation form. The eight categories included “body posture, preparatory gesture,
placement of meter pattern, cueing and releases, independence of hands, character of
gesture as it portrays musical detail, facial expression and eye contact, and dynamic
indication” (72).

The study followed the procedure of pre-test, treatment and post-test. The purpose
of the pre-test was to establish two equal groups. Students were ranked, paired and
randomly assigned to the experimental or control group. During the treatment, both
groups followed regular class sequence, including regular class meetings and Laboratory
Chorus experience. Experimental group students used the guided practice materials,
including the score study guide, special conducting considerations, and a self-evaluation
guide. They were assigned specific conducting literature for each unit of the project.
These students were granted two private video-practice sessions in an audio-video studio.
Used equipment allowed students to observe their own performance on the monitor as
they conducted. Suggestions were also provided for improving their use of practice time.
For the self-evaluation, students replayed their video-practice conducting and assessed
their conducting by using the evaluation form, and then identified areas that needed
further practice. In contrast, control group students chose their own choral selections and
followed the usual course procedure. The treatment lasted seven weeks. Students
conducted one piece for the post-test that presented several advanced challenges in music
and conducting demands (facial expression, gesture character, and posture). The result of
the study showed significant improvement of guided materials with videotaped recording
on students’ conducting skill. “Nine members [out of ten pairs] in the Experimental
Group scored higher on the post-test than their partners in the Control Group” (65).
Fleming concluded that the guided practice materials with videotape recorder could
function as an “extension of an instructional sequence in which videotaped conducting experience and private playback/discussion were a primary feature” (66). To be specific, the guided practice materials presented a “behavioral conducting goal” while the “self-evaluation via videotaped instant replay enabled students to assess as objectively as possible their achievement of established goals” (66).

Teaching piano via television initiated the use of video technology in piano teaching (Erlings 1970; Fore 1976; Mach 1978; Giles 1981). Mach (1978) designed and produced a closed circuit video instructional series for the beginning level of the first trimester of class piano at a university. The video instruction included fifteen video lessons and ten reinforcement tapes, covering keyboard theory, postures and the use of body (arms, hands, and fingers), skills and techniques, chord progression, harmonization, transposition, and improvisation. Students watched the video presentation first through television monitors, and then the instructor provided further explanations and illustration of techniques. Absent students could schedule to watch the replay in the piano lab. The reinforcement tapes were designed for students to use in the lab when the teacher was not present, providing additional guidance for the common difficulties during practice. Mach suggested the transfer of these video instructional materials to video cassettes so students could use them at home and progress at their own pace. According to Mach (1978), with the accessibility of television at home, the video cassette could serve as a tremendous supplementary teaching aid, reinforcing the concepts and techniques students had learned in class and allowing teachers to cover more material during class time.

Giles (1981) investigated the effectiveness of teaching adult beginners to play the piano via televised instruction exclusively. According to Giles (1981), there are two
educational functions of using televised instruction in teaching piano beginners. First, the
closed circuit televised instruction allowed individualized pacing of instruction in a group
setting where entry-level piano students have varied levels of experience. Second,
broadcast television makes piano instruction available in the home for those students who
are unable to attend piano lessons. In this study, the researcher wrote a textbook for
teaching adult beginners and worked with the local television station for the production
of thirty half-hour telecourses. Four camera operators captured multiple angles of
viewing. For example, one camera captured “the teacher’s hands on the keyboard exactly
the way they appear to him” (20). The production of the video also used video-graphic
tools, such as split screen, vidifront, highlighting, and editing. Two different modes, the
closed-circuit mode and the broadcast mode, were tested and evaluated in this study. In
the closed-circuit mode, thirty-one (N=31) students from class C and D worked with
videotapes and the textbook, in comparison to thirty-one (N=31) students from class A
and B who were given a conventional class piano situation with the textbook. The result
of similar distribution of grades between the two groups indicated that “closed circuit
television can be as effective as conventional instruction for teaching the piano” (71).
However, only 29% of the students in the television group completed the course while 48%
in the conventional class did. Giles explained that students from the television group
“with less identification with the instructor and with less classroom opportunity to
experience playing in front of others, are even more intimidated by the anticipation of the
final examinations” (73).

3 According to Giles (1981), “vidifont is the technique of creating words on the television
screen electronically. These words, or groups of words, can be superimposed on any
picture” (28).
In the broadcast mode, thirty programs were broadcasted over seventeen weeks in an academic semester through the local television. Two sequential programs were shown each week with each program aired twice in that week. The researcher used two colleges and one library as three viewing stations. Each was equipped with pianos, television playback equipment, and complete sets of tapes for the students who had missed any broadcast or wanted to review the videotapes. Four quizzes were given to reinforce the concepts and techniques. Students received the quiz by mail and submitted it to the college. The quizzes were evaluated by computer and were returned to students within a few days. Students’ actual achievements were evaluated by individual performance examinations held in the midterm and the final exam. In regard to the number of participants, two hundred and twenty-six students initially appeared on the roster while ninety-four students were considered the best estimate of the actual number of students beginning the course. Twenty-Six \((N=26)\) students completed the course by taking the final exam, which represented a retention rate between 27% and 28%. Possible explanation for the low retention rates include: generally low retention rates in this community college, a demand for regular commitment of time and progress within a short time, few students registering for the purpose of degree, and fear of playing in front of an instructor. Among the twenty-six students who completed the final exam, twenty students received an A or B. Giles concluded that “[enough] students in this study did learn to play the piano well, using either the closed circuit or the broadcast modes of communication, to indicate that televised piano instruction is viable, at least at the beginning levels of instruction” (92).
Researchers showed less interest in teaching piano via television in the recent three decades and literature in this field is limited. With the rapid development of digital technology and the internet in the twenty-first century, videos can be easily produced through personal devices, such as camera or phones, and can be shared immediately online. However, very few studies have discovered the effects of using video modeling in piano teaching. Payne’s (2010) study investigated the effect of model performances posted on the internet on expressive performance of young piano students. Forty-three ($N=43$) students, 7-14 years old, enrolled in private piano lessons from seventeen piano teachers were divided into four groups according to age. They were randomly assigned to one of the two conditions: watching either expressive performance video or static performance video. The researcher composed four pieces from elementary to intermediate level of difficulties. The models of both performance conditions were video-recorded by a university piano professor. Two conditions of performance were posted on different sites to avoid participants viewing the opposing performances. The piano teachers received specific instruction for this study and portions of three consecutive piano lessons were required. At the first lesson, students watched the model performance on the internet before sight-reading the piece. They were also required to watch the video at home. Students’ performances were recorded at the third lesson in an audio form to avoid the visual perception influence. Their performances were rated by Likert scale including expression and technique aspects. Specifically, “the expression elements included crescendo/diminuendo, dynamic contrast, forward motion/direction, tapering of phrases, intentional speeding up or slowing, and holding the fermata, [and technical] elements for evaluation included accuracy of notes and rhythm, clarity, control of
pace/steadiness of tempo, and tone quality” (28). The result of the study showed that the students viewing expressive model performance received higher scores than the students viewing static model performance; however, the former students received lower scores for technique. The researcher explained that students might imitate better rhythmic continuity and steadiness when watching the static model performance, or the judge tended to rate higher for technique because this aspect overshadowed the expressive aspect. It is also possible that students in the expressive condition intended to imitate the expressive elements of the performance, which caused irregularities in tempo and dynamics.

Observational Learning

According to social learning theory, most human behavior is acquired observationally through modeling (Bandura 1977, 1986). Human behavioral learning can be classified into two controversial theories: behavioristic and cognitive (Gestalt) theory (Kleinman 1983). Behaviorists stress the association of a stimulus and a response and reinforcement of a response from trial and error; to the contrary, cognitive theorists assert that learning requires learners’ capability to comprehend and organize the elements from learning tasks and to interact with the environment (Kleinman 1983). From Kleinman’s perspective, “the study of the acquisition of complex motor skills involves both movement and cognition, neither behavioristic nor cognitive theories alone can satisfactorily account for the process involved in motor learning” (33).

Bandura and Jeffery (1973) challenged behaviorists’ views by proposing a situation where observers may have no response at the time of modeling exposure, but this response may be displayed at a much later time when the model is not present.
Therefore, the modeled information has to be represented in a certain form in memory to serve as a future guide for actions. Bandura (1977, 1986) proposed four sub-processes of observational learning that have been widely accepted in explaining human behavioral learning. These processes are 1) attentional process, 2) retention process, 3) production process, and 4) motivation process. In this framework, the attentional and retention processes affect acquisition of modeled information from observation, whereas the production and motivational processes regulate performance (Bandura and Jeffery 1973). Bandura’s observational learning theory indicates that acquiring a complex motor skill involves cognitive realization prior to physical action. His learning theory serves as the primary guidance for the experimental design of this study.

The attentional process is the process of selecting and extracting information from ongoing modeled events. The amount of information an observer can perceive and the accuracy of perception affect how much he or she can learn. Various factors could influence an observer’s attention and perception at this initial stage of observational learning, including the salience, discriminability, and complexity of modeled events, as well as perceptual capabilities, perceptual sets, cognitive competencies, and preconceptions of an observer (Bandura 1986). Bandura (1986) indicated that increasing the number of exposures is needed if the modeled skills are too complex for the observer’s cognitive competency.

In the retention process, the selected information must be coded into symbolic forms represented in memory for future action (Bandura 1986). Bandura and Jeffery (1973) investigated the role of symbolic coding and rehearsal during the retention process of observational learning. In this study, forty-four males and forty-four females ($N=88$)
from introductory psychology courses were randomly assigned to nine experimental and two control groups. Eight novel modeled configurations were created for the test. Each configuration on film consisted of six sequential component actions in varying distances and directions. There were three coding conditions for each component move: 1) numerical code, 2) verbal code (alphabet letter), and 3) no pre-assigned code. To test the effects of the meaningfulness of codes on retention, the configurations included codes with familiar number sequences or less organizable numbers for numerical coders, as well as meaningless letter aggregates or familiar words for verbal coders. Both experimental and control groups watched the modeled performances, but only the experimental groups were instructed to learn the corresponding codes for each component move. During the rehearsal, the experimental groups in three coding conditions were further divided into three types of rehearsal: 1) motor rehearsal, 2) symbolic rehearsal, and 3) no rehearsal. For the motor rehearsal group, subjects practiced overtly the modeled patterns as many times as they wished during the allotted time. For the symbolic rehearsal group, subjects verbalized the symbolic code and repeated it many times in the same period. A film was shown for the third group to prevent them from rehearsing. The result of the study showed the observers who coded the modeling stimuli in symbolic form and immediately rehearsed the memory code achieved the superior performance. In delayed response reproduction, subjects who rehearsed symbolically retained the response information better than those who rehearsed motorically. To the contrary, if the observers did not rehearse immediately in symbolic code, the response information was forgotten, which caused deficiency in imitative performances. In
addition, modeled responses were learned and retained better when the symbolic form was familiar and meaningful.

The production process is the process of converting the symbolic forms to appropriate actions. Bandura (1986) stated, “[behavioral] production primarily involves a conception-matching process in which the incoming sensory feedback from enactments is compared to the conception. The behavior is then modified on the basis of the comparative information to achieve progressively closer correspondence between conception and action” (64). Caroll and Bandura (1987) investigated the role of two forms of visual guidance in facilitating the conception-matching process. The first form involved “visual coordination of performance with a cognitive representation of the modeled actions”, and the second form involved “visual coordination of performance with ongoing modeled actions” (386). Twenty male and twenty female undergraduate (N=40) students were randomly assigned into four conditions. In the concurrent matching condition (the second form), subjects observed the modeled performance, and then performed concurrently with the model to match the performance. In the separate matching condition (the first form), subjects performed after observing the modeled performance. The angles of video cameras were adjusted to ensure equal visual feedback from the subject’s performance and modeled performance. Subsequently, a test of reproduction was given without model’s presence, half of participates in each above condition either did or did not visually monitor their actions during the test. The sequence of matching the performance and reproduction test repeated four times. Subjects had two

---

4 In the separate modeling condition, subjects first observed the modeled action, and then performed it without the model’s presence; therefore, a certain amount of information had to been cognitively presented in memory, which guided future actions.
additional tests in the end for reproduction accuracy without the aid from the model and visual monitor, so a total of six tests were given. In addition, cognitive representation tests, including recognition of component responses and a pictorial arrangement test of component responses’ sequence, was provided after the 2nd, 4th, and 6th test for reproduction accuracy. The result of the study showed that the concurrent matching condition or the groups visually monitoring their performances during reproduction tests (either in the concurrent or separate matching condition) increased the level of observational learning. To the contrary, subjects in the separate matching condition and could not visually monitor their actions during reproduction tests showed a low level of observational learning. This indicates the importance of visual guidance of the self during the performance, which aids error detection and correction. Another finding was that cognitive representation was not affected by either concurrent matching or visual monitoring, but developed with the increasing number of exposures to the modeled information. In terms of the correlations between cognitive representation and the reproduction, the researchers concluded that “the more accurate the cognitive representation, the more skilled were subsequent reproductions of the modeled actions” (385).

In addition, Bandura (1986) proposed that learners usually cannot fully observe their behavior; therefore, they may practice incorrect responses repeatedly while assuming that they are following the required actions. In reflecting how piano learners practice a piece, the researcher noticed that they needed to visually coordinate between music scores and hand movements. It is unlikely for the piano learners to observe all of their physical movements as they play, even if they focus exclusively on their hand
motions, since their vision is limited to one angle of view. Therefore, feedback information plays an important role during the reproduction process. According to Bandura (1986), “[feedback] augmented by information provided visually, auditorily, or verbally is most likely to facilitate learning when one’s performances are only partially observable or the natural feedback is difficult to monitor and perceive” (67). Moreover, with the increasing use of video feedback for self-observation, Bandura (1986) pointed out that learners who simply observe their own performance may generate unpredictable effects, and structured feedback is needed to guide their attention to the related aspects and make corrective changes. The quoted study by Palao et al. (2015) from the beginning of this section showed that novice learners significantly improved their techniques through observing their own performance via videos and receiving the prompt feedback from the teacher.

Kernodle and Carlton’s (1992) study investigated the effects of different forms of feedback on learning an overhand throw, which is a multiple-degree-of-freedom activity. The different forms of feedback include 1) knowledge of results (KR), 2) knowledge of performance (KP), 3) knowledge of performance with attention-focusing cues, and 4) knowledge of performance with error-correcting transitional information. Forty-eight subjects (N=48) ranging from 15-40 years old were randomly assigned into one of these four groups. They had no throwing experience with the non-dominant arm. They participated in 12 practice sessions for four weeks, in a total of 600 practice trials. During the training, they observed a modeled performance demonstrated by a skilled left-handed thrower through video monitor after every tenth trial. In the first condition, the experimenter provided knowledge of results verbally. In the latter three conditions,
subjects observed a video replay of their throwing pattern on the just-completed trial. The second group (KP) observed their own performance without receiving knowledge of results. The third group (KP with cue) was instructed where they should focus their attention prior to viewing the video. The fourth group (KP with transitional information) were instructed how to improve their performance on the subsequent trial while they were observing their response through video. All subjects were assessed with respect to both throwing distance and throwing form. The result of the study showed that subjects who received KP with cues or transitional information demonstrated larger performance gains and higher form ratings than the students who received KR or KP without additional information. As the researchers indicated, “the presentation of KR alone or KP without additional information may not be sufficient to learn multiple-degree-of-freedom whole body actions” and additional instructions are needed to aid learning (Kernodle and Carlton 1992, 193).

The last process of observation learning is the motivational process, which determines if the modeled activities will be performed after the acquisition and how often this skill will be used in the future. Acquired behavior may not be always performed due to low motivation; thus positive incentives are important for learners to continuously profit from learned skills (Bandura 1986). Bandura further indicated three types of positive incentives, including external incentives, vicarious incentives, and self-incentives. Bandura (1986) discussed these factors thoroughly in the later chapters of the book Social Foundations of Thought and Action: A Social Cognitive Theory. Because the primary focus of this study is the first three subfunctions of observational learning, motivational process will not be further discussed in this chapter. Overviewing the four
sub-processes of observational learning, Bandura indicated, “[in] any given instance, faulty modeling may result from deficiencies in any of the four subfunctions” (1986, 70). The design of the videotape and how to implement the videotape during learning a skill needs to follow the guidance in each process to maximize the potential benefits of using video modeling.

**Design and Procedure**

The study comprises four chapters, references, and appendices. Chapter 1 includes the introduction, purpose of the study, research questions, need for the study, limitations, review of literature, and design and procedures. Chapter 2 presents the methodology of the study. Chapter 3 presents the results of the study. Chapter 4 consists of a summary and conclusion, and recommendations for future studies.
CHAPTER 2
METHODOLOGY

The primary goal of the study was to investigate the effectiveness of video modeling with video feedback for developing mid-to-late elementary piano students’ motor skills in learning a given piece. In addition, the researcher explored further if this method would benefit students’ other aspects of performance, including pitch/rhythm accuracy, dynamics, balance, and artistry, as well as facilitate the retention of the performance.

Video modeling in this study included the use of expert-modeling, self-modeling, and the contrast of two models. The researcher modified the method of model’s superposition; in other studies the expert’s model and self-model were displayed in a split screen and played simultaneously for motion comparison. In the present study, it was not possible to play the videos simultaneously because of interference between the recorded sound from both videos; thus, the researcher played the expert and self-model in succession. In addition, video modeling in this study integrated video feedback—displaying, analyzing, and comparing videos of self-modeling and expert-modeling via a motion analysis application.

The research used a multiple baseline design across behaviors. Five participants learned a new piece during three consecutive weekly lessons, and their individual progress was recorded through multiple tests. In the first lesson, the participants learned
the piece in a conventional way; specifically, they observed the researcher’s demonstration, and then imitated the movements while the researcher provided verbal feedback. During the second and third lessons, video modeling with video feedback was used mainly for three targeted skills: the left-hand performance (legato) and the right-hand performance (staccato) in week two, and the hands-together performance (hand coordination) in week three. Specifically, the participants were asked to observe expert-modeling (in regular speed and in slow motion) via a main display screen and to replicate the performance while they used two display screens as a mirror to monitor their hand motions from two different viewing angles. A short segment of the participants’ performances were then recorded for self-modeling. The researcher provided verbal feedback as the participants observed self-modeling in contrast to expert-modeling via motion analysis software. After the three consecutive weekly lessons, no further live instruction was given. The participants came to the research room to record post-test I in week four and post-test II in week five.

In addition, during the second and third week of practice (after the second and third lesson), the researcher provided video modeling with video feedback for participants to use at home; this included videos of expert-modeling and feedback videos of self-modeling recorded in the previous lesson in comparison to the expert-modeling. Video materials were removed immediately after post-test I. Therefore, there was no video assistance during the fourth week of practice prior to the final test of the study (post-test II).
Participants

The researcher selected the participants from students at the mid-to-late elementary level who were enrolled in the Center for Piano Studies at the University of South Carolina (USC). The researcher reviewed students’ annual reports from May 2017, and recital repertoire from December 2017 to determine potential candidates. Participants were not the students of the researcher. In addition, the researcher consulted the teachers to verify the students’ suitability for the project, asking them to consider factors of age, level, maturity, and ability to process verbal instruction. There was no discrimination based on gender, race, and religion. Selected participants demonstrated varied levels of ability at an individual baseline; however, the goal of the study was to track individual progress before and after using video modeling with video feedback during the lesson and home practice.

Prior to selecting the participants, the research study was approved by the Institutional Review Board (IRB) at the University of South Carolina for exempt review (see appendix A), followed by the approval letter from the Center for Piano Studies (see appendix B). After determining the participants, the researcher provided a summary letter with a description of the study to each participant’s teacher via email (see appendix C). The researcher presented the Letter of Invitation (see appendix D) to the participants’ parents within a week before the study and explained the procedure and requirements of participation.

Five participants (3 females and 2 males), 8 to 9 years old, were selected to participate in this study. The researcher assigned a nickname for each participant at the beginning of the study. Table 2.1 shows their assigned nicknames and basic information.
Table 2.1. Participants’ information

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Age</th>
<th>Years of Piano Study</th>
<th>Current Method Book and Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amy</td>
<td>9 years old</td>
<td>2 years</td>
<td><em>Alfred’s Premier Piano Course, Lesson 2A</em></td>
</tr>
<tr>
<td>Charles</td>
<td>8 years old</td>
<td>3 years</td>
<td><em>The Music Tree, Part 2B</em></td>
</tr>
<tr>
<td>Ella</td>
<td>8 years old</td>
<td>2 years</td>
<td><em>Piano Safari, Book 1</em></td>
</tr>
<tr>
<td>Nicholas</td>
<td>8 years old</td>
<td>2.5 years</td>
<td><em>The Music Tree, Part 2A/Piano Adventure, Lesson book 1</em></td>
</tr>
<tr>
<td>Sophia</td>
<td>9 years old</td>
<td>1 years</td>
<td><em>Royal Conservatory Celebration Series, Preparatory B</em></td>
</tr>
</tbody>
</table>

**Teaching Piece**

The selected piece in this study was “Polka” from *Twenty-Four Pieces for Children*, Op. 39, by Dmitri Kabalevsky (see figure 2.1). This piece is graded level 1 by Jane Magrath\(^1\) (1995), and this eight-measure piece features a *legato* melody in the left hand accompanied by *staccato* harmonic intervals in the right hand on off-beats. According to the teachers’ reports, no participants had learned this piece prior to this study. The technique that required left-hand *legato* motion against right-hand *staccato* motion was relatively new to all the participants prior to participating in this study. The researcher purchased five copies of the piano solo from Sheet Music Direct\(^2\) and provided a printed copy to each student at the first lesson. The researcher made one

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1 Magrath (1995) evaluated and graded piano solo teaching literature from the Baroque period, Classical period, Romantic period and 20\(^{th}\)-century into 10 levels according to technical and musical difficulties. Level 1 is the easiest level in her grading system.

Figure 2.1. Polka from *Twenty-Four Pieces for Children*, Op. 39, No. 2, by Dmitri Kabalevsky (see permission to print in Appendix E).
change in fingering. Instead of using fingers 2 and 4 in the right hand for the harmonic third (m. 1, 4, 5, right hand), the researcher changed it to fingers 1 and 3. Therefore, the participants could begin the piece with placing both hands in C major five-finger position. Moving the right-hand thumb a step down to B and a step up back to C in advance was one of the key finger movements that was addressed during the teaching segments.

**Technology**

Three cameras were used in this study, including two GoPro Hero 5 and one camcorder Canon VIXIA HF M41. The two GoPro cameras were mounted at two different angles to capture the side view and overhead view of the researcher and participants’ hand movements. The camcorder recorded the entire process of the study in a panoramic view.

Two personal devices were used to control the GoPro cameras remotely and display videos from the GoPro cameras. The devices included one iPad with a 9.7-inch screen (main display screen) and one iPhone with a 4.7-inch screen. During the lesson, the researcher paired the iPad with the GoPro camera that captured the side view of hands, and paired the iPhone with the GoPro camera that captured the overhead view of hands. The researcher had to be flexible with pairing during the study due to unexpected technical issues. The application Slowmo Video Analysis by Pico Brothers\(^3\) was downloaded to the iPad and the iPhone for slow-motion analysis and comparison of two videos. Figure 2.2 is the diagram of the technology setup for this study. Appendix H includes a photo of the research room, and this shows the setup of the GoPro cameras.

\(^{3}\) Pico Brothers is founded in 2009, a company build mobile App for iOS and Android system. Http://www.picobrothers.com (accessed October 5, 2018)
Figure 2.2. Technology design and setup.

The two GoPro cameras recorded the researcher’s demonstrations prior to the study as well as the participants’ performances during the lessons. These cameras captured the side view and overhead view of hand movements. The researcher recorded herself playing “Polka” with separate hands and hands together in a performance-level tempo prior to the first lesson. These videos were uploaded to the iPad and served as the expert-modeling for use in the lessons. During the three weekly lessons, the GoPro cameras captured the same two views of participants’ performances. These participant recordings were used for self-modeling and test evaluations.

The setup of the GoPro cameras was modified each time prior to the lesson due to the change of research rooms. All the classrooms are shared space for the instructors at the USC School of Music. The researcher switched among four different classrooms with a grand acoustic piano for this study. Therefore, the researcher needed to mount the GoPro cameras each time before the lesson and remove it after the lesson. Although the
scenes captured by the GoPro cameras were slightly varied for each lesson, this would not affect the evaluative measurements used to assess participant performance.

In addition, the entire process of the study, including the pre-test, three weekly lessons, and two post-tests, were video-recorded in a panoramic view on the Canon camera. These videos were used as reference for the entire study.

Research Structure and Planning

The full-scale research was carried out in five weeks. The researcher conducted three 35-minute to 40-minute weekly lessons in the first three consecutive weeks. The pre-test was conducted at the beginning of the first lesson. Two post-tests were conducted on the fourth and fifth weeks respectively. Between the three weekly lessons and two post-tests, there were four weeks of home practice. Table 2.2 indicates the structure of the experimental design.

The lesson in each week involved multiple parts, including one technical warm-up period (from week two), several teaching segments, and one self-practice period. The researcher assigned parts (P) with a number to mark the week, and an alphabetic letter to mark the lesson segment. For example, all the lesson segments in week one were named Part 1 (P1), and the alphabetic letters after P1 denoted the order of the segments (P1/A, P1/B, P1/C). In week two, all the parts (lesson segments) were named P2, and so forth. Each part was followed by a test (T), which was assigned a same number and letter with the corresponding session. For example, the part P1/A was followed by the test T1/A.
Table 2.2. Structure of the experimental design

<table>
<thead>
<tr>
<th>Week No.</th>
<th>Lesson/ Home Practice</th>
<th>Components (estimated time)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><em>Part (P), Test (T), Left Hand (L.H.), Right Hand (R.H.), Hands Together (H.T.)</em></td>
</tr>
<tr>
<td>1</td>
<td>Lesson (38 min)</td>
<td>• Pre-test (5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P1/A: Teaching segment—learn the piece hands separately (14)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T1/A: Hands separately (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P1/B: Teaching segment—work on hands together (8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T1/B: Hands separately, hands together (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P1/C: Self-practice period (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T1/C: Hands separately, hands together (3)</td>
</tr>
<tr>
<td></td>
<td>Home Practice</td>
<td>• Assignment sheet week 1</td>
</tr>
<tr>
<td>2</td>
<td>Lesson (41 min)</td>
<td>• P2/A: Technical warm-up (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T2/A: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P2/B: Teaching segment—video modeling for L.H. (10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T2/B: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P2/C: Teaching segment—video modeling for R.H. (10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T2/C: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P2/D: Teaching segment—work on hands together (5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T2/D: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P2/E: Self-practice period (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T2/E: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td>Home Practice</td>
<td>• Assignment sheet week 2, video materials (either L.H. or R.H.)</td>
</tr>
<tr>
<td>3</td>
<td>Lesson (36 min)</td>
<td>• P3/A: Technical warm-up (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T3/A: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P3/B: Teaching segment—work on hands together (6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T3/B: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P3/C: Teaching segment: video modeling for H.T. (16)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T3/C: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• P3/D: Self-practice period (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T3/D: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td>Home Practice</td>
<td>• Assignment sheet week 3, video materials (H.T.)</td>
</tr>
<tr>
<td>4</td>
<td>Post-test I (5 min)</td>
<td>• Technical warm-up (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Post-test I: Hands separately, hands together (2)</td>
</tr>
<tr>
<td></td>
<td>Home Practice</td>
<td>• Assignment sheet from week 3</td>
</tr>
<tr>
<td>5</td>
<td>Post-test II (5 min)</td>
<td>• Technical warm-up (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Post-test II: Hands separately, hands together (2)</td>
</tr>
</tbody>
</table>
Pre-test

The purpose of the pre-test was to evaluate participants’ technique and sight-reading ability. The pre-test was given at the beginning of the first lesson. The technique pre-test was a 5-finger pattern in the key of C major (see figure 2.3). The participants received the technique pre-test handout (see appendix F) when the researcher presented the invitation letter and introduced the study to their parents. The researcher explained the technique exercise requirement to the participants. They were aware that a technique test would be given at the beginning of the first lesson. During the pre-test, the participants were asked to play in the following sequence (see table 2.3).

![Fingering: R.H. 1 2 3 4 5 4 3 2 1 3 5 3 1 5 1 5 1 L.H. 5 4 3 2 1 2 3 4 5 3 1 3 5 1 5 1](image)

**Figure 2.3. Technique pre-test.**

<table>
<thead>
<tr>
<th>Technique test sequence</th>
<th>Technique Test Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>R.H., <em>legato</em>, quarter note = 72bpm (beats per measure)</td>
</tr>
<tr>
<td>No. 2</td>
<td>L.H., <em>legato</em>, quarter note = 72bpm</td>
</tr>
<tr>
<td>No. 3</td>
<td>H.T., <em>legato</em>, quarter note = 72bpm</td>
</tr>
<tr>
<td>No. 4</td>
<td>R.H., <em>staccato</em>, quarter note = 72bpm</td>
</tr>
<tr>
<td>No. 5</td>
<td>L.H., <em>staccato</em>, quarter note = 72bpm</td>
</tr>
<tr>
<td>No. 6</td>
<td>H.T., <em>staccato</em>, quarter note = 72bpm</td>
</tr>
<tr>
<td>No. 7 to No. 12</td>
<td>Repeat sequence No. 1-6, quarter note = 120bpm</td>
</tr>
</tbody>
</table>
The researcher expected that all the participants had developed the basic skill of playing a C five-finger pattern at 72bpm in legato and staccato prior to the study. The targeted tempo the researcher suggested for practicing “Polka” during the first week of practice was 72bpm. The final performance tempo the researcher set for this study was 120bpm.

The sight-reading example (see figure 2.4) was given during the pre-test. This example includes all the pitches that appeared in “Polka.” Prior to the participants’ playing, the researcher reminded the participants that both left and right hands were notated in the treble clef. The researcher also guided them to identify the starting pitch for each hand and made sure that they placed their hands on the correct registers of the keyboard before they played. The participants were given 20 seconds to prepare this piece prior to the test.

![Figure 2.4. Sight-reading pre-test.](image)

**Teaching Segments and the Use of Technology**

There were seven teaching segments during the three weekly lessons. The first lesson included two traditional teaching segments that introduced playing “Polka” hands separately and hands together respectively. The second lesson included two video modeling teaching segments that addressed the left-hand and the right-hand performance
respectively, as well as a traditional teaching segment for the hands-together performance.

The third lesson focused on the hands-together performance, and included a traditional and a video modeling teaching segment. All the video modeling teaching segments incorporated video feedback, a process of analyzing self-modeling and/or comparing it to expert-modeling via a motion-analysis software. Table 2.4 provides the detailed planning for each teaching segment.

Table 2.4. Lesson plan for teaching segments

<table>
<thead>
<tr>
<th>Lesson No.</th>
<th>Teaching Segment</th>
<th>Lesson Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P1/A Traditional</td>
<td>*Teacher (T), Student (S), Right Hand (R.H.), Left Hand (L.H.), Hands Together (H.T.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T demonstrates the piece; discuss the character and articulation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guide reading through L.H., identify and compare two larger phrases (mm.1-4 and mm. 5-8), and then focus on legato and breathing motions. Explain tenuto marking in the end.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guide reading through R.H., identify the harmonic intervals (third and sixth), and then focus on finger movements and staccato motions.</td>
</tr>
<tr>
<td>2</td>
<td>P1/B Traditional</td>
<td>Work on mm.1-4 hands together slowly. Practice opposite hand motions: first, only play the beat when both hands have notes and freeze that motion, second, gradually add other notes in both hands. T prompts how finger moves as they play.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Work on mm. 5-8 hands together with the emphasis of opposite hand movements and how finger moves; address hand coordination in the last measure.</td>
</tr>
<tr>
<td></td>
<td>P2/B Video Modeling (with video feedback)</td>
<td>Work on L.H.: S observes T’s model through the video while T guides S’s attention to a specific movement at a time (legato, breathing, thumb’s motion at mm. 6, and tenuto touch in the end). Play the video in a normal speed and slow motion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S replicates the motions after observing T’s model in the video. S can monitor their movements captured by GoPro cameras simultaneously on the display screens. S practices few times, and the last attempt is recorded and compared to T’s model. T provides verbal feedback and S tries a few times.</td>
</tr>
</tbody>
</table>
times to correct the errors.

- One selected video recording will be used to create feedback video and sent to S after the lesson if S has been assigned to watch L.H. videos for home practice

| P2/C Video Modeling (with video feedback) | • Work on R.H. harmonic intervals with the assistance of video modeling/feedback by following the same steps in P2/B. The specific movements include \textit{staccato} motion, finger movements, hands extension and contraction, and motions of a two-note slur with tenuto touch.
• One selected video recording of R.H. performance will be used to create feedback video and sent to S after the lesson if S has been assigned to watch R.H. videos for home practice |
|---|---|
| P2/D Traditional | • S practices on the piano lid and focuses on the opposite motions of both hands, and then plays on the keyboard.
• Practice L.H. \textit{legato} line against R.H. \textit{staccato}
• T demonstrates the last measure and explains hand movements |
| 3 | P3/B Traditional | • Work on hands together. T demonstrates and provides verbal feedback. The specific movements include opposite motions between hands, L.H. \textit{legato} line against R.H. \textit{staccato}, L.H. slow breathing motion against R.H. quick \textit{staccato} motion, and tenuto touch in the end. |
| | P3/C Video Modeling (with video feedback) | • Work on hands together with video modeling/feedback by following the same steps in P2/B session. The specific movements include opposite motions between hands, L.H. \textit{legato} line against R.H. \textit{staccato}, L.H. slow breathing motion against R.H. quick \textit{staccato} motion, and tenuto touch in the end. The problems that cannot be resolved under the traditional instruction will be prioritized.
• One selected video recording of H.T. performance will be used to create feedback video and sent to S after the lesson. |

The study consisted of three video modeling teaching segments: P2/B, P2/C, and P3/C. The following text described how the researcher used the GoPro cameras, display devices, and application Slowmo during the video modeling teaching segments.

The videos of expert-modeling with two views were imported to the 9.7 inch iPad (main display screen) prior to the lessons. In the video modeling teaching segment, the researcher played the videos at regular speed and slow motion through the application.
Slowmo. The researcher provided verbal cues to guide the participants to observe the videos. In addition, various tools in Slowmo drew the participants’ attention to specific details of hand movements, including slow motion, split screen, and drawing tools. During video observation, the researcher used the drawing tools in the application to point out specific issues of hand movements. To reinforce visual memory of certain movements, the researcher scrolled the video timeline forward or backward slowly or froze the video at a certain spot. Verbal guidance was provided during the video observation to facilitate understanding of certain movements.

When the participants imitated the hand movements of the expert’s model, they used two display screens (iPad and iPhone) as mirrors to monitor their hand movements. These two display screens were placed on the piano rack in front of the participants. The iPad was usually paired with the GoPro camera that captured the side view of the hands. This angle was good for observing hand posture and wrist breathing motions. The iPhone was usually paired to the GoPro camera that captured the overhead view of the hands. This angle was suitable for observing the use of fingertips and finger movements to new positions.

Video feedback was provided throughout the video modeling teaching segments. The researcher used GoPro cameras to record a short segment of their playing after several attempts of replication. The video was imported wirelessly to the iPad or iPhone, and then was played back via Slowmo in regular and slow motion for motion analysis. During this process, the researcher guided the participants to observe self-modeling and comparison to expert-modeling.
Practice Guideline and Assignment

The researcher asked, as indicated in the consent form, all the participants to practice this piece consistently throughout the week. Daily practice for 10 minutes was recommended. If daily practice was not possible, the researcher requested a minimum of 15 minutes of practice every other day, for a total of 45 minutes during the week. In addition, the participants were asked not to skip practicing this piece two days in a row.

The weekly assignment sheet included a practice guideline, additional comments from the researcher, and home practice reports from the parents (see appendix G). The practice guideline (see table 2.5) indicates what the participants were expected to practice at home. The researcher presented the assignment sheet before the self-practice period towards the end of each lesson, and went through all the details of the practice guideline with the participants. The researcher also wrote down specific comments for each participant under the category of Additional Comments in the assignment sheet. The participants used this assignment sheet for a few minutes of self-practice during the lesson prior to the last test of the day, and took it home with them for practice.

Table 2.5. Practice guideline

<table>
<thead>
<tr>
<th>Practice week no.</th>
<th>Practice Guideline</th>
</tr>
</thead>
</table>
| Week 1            | • Work on the fluency of individual hands  
|                   |   - Pay attention to L.H. *legato* lines and breathing motions.  
|                   |   - Understand how fingers move in R.H.  
|                   | • Practice hands together slowly, be able to coordinate different articulation of each hand. Segmented practice is recommended.  
|                   | • Goal Tempo this week: quarter note = 60-72 |
| Week 2            | • Work on the articulation of individual hands and focus on the specific R.H. or L.H. movements mentioned in the lesson  
|                   | • Practice hands together. Slow and segmental practice is recommended  
|                   | • Goal tempo this week: quarter note =80-100  
|                   | • Watch feedback videos |
Week 3

- Work on hands together and focus on specific coordination issues and hand movements mentioned in the lesson
- Goal tempo this week: quarter note = 120
- Watch feedback videos

**Video Materials for Home Practice**

In addition to weekly assignment sheets, the researcher sent video materials to the participants after the second and third lessons for home practice. The video materials included expert-modeling and feedback videos of self-modeling in comparison to expert-modeling.

Table 2.6 shows the design of video materials for home practice. In the second week of practice, the researcher shared the videos partially. The participants either received the videos of expert-modeling and feedback video of the left-hand performance or received the videos of expert-modeling and feedback video of the right-hand performance, which was randomly assigned by the researcher before the experiment (see table 2.7). In the third week of practice, the researcher shared the videos of expert-modeling and feedback video of the hands-together performance while removing the video materials from the previous week. In the fourth week of practice, all the video materials were no longer available for the participants to use at home. They were asked to continue working on the piece for the final performance (post-test II) in the fifth week.

**Table 2.6. Video materials for home practice**

<table>
<thead>
<tr>
<th>Home Practice Week No.</th>
<th>Video Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>Either video materials for L.H. performance or video materials for R.H. performance</td>
</tr>
<tr>
<td>3</td>
<td>Video materials for H.T. performance</td>
</tr>
<tr>
<td>4</td>
<td>N/A</td>
</tr>
</tbody>
</table>
The researcher used the motion-analysis application Slowmo to create videos of expert-modeling and feedback videos of self-modeling. One of the features of the application is to create telestration. This feature allowed the researcher to record her verbal comments while playing a video at any speed the researcher wanted. The researcher could also add text comments and highlight markings (arrows or shapes) over a moving video image. For motion comparison, the researcher put two videos (expert-modeling and self-modeling) into a split screen, and played these two videos in succession.

The videos of expert-modeling were played at a regular speed first, followed by slow-motion replay with additional verbal cues from the researcher. Both side view and overhead view of expert-modeling were included. The researcher added text comments and highlighted markings to guide the observation.

For the feedback videos of participants’ self-modeling, the researcher selected one of his or her recordings from the previous lesson and used Slowmo to create a personalized feedback video for each participant. The length of each feedback video is eight to ten minutes. All the feedback videos begin with participants’ self-performance in
the side and overhead views at a regular speed. Prior to viewing the recorded self-performance, the researcher instructed the participants to pay attention to specific aspects of their performance, such as hand positions, finger movements, wrist motions, etc. Then the researcher analyzed the participants’ performance in slow motion in both angles. The researcher recorded her verbal comments along with the videos, and used the application features—such as text comments, highlight markings, and a comparison video of expert-modeling on the top of self-modeling—to address specific issues of individuals. Example 1 and Example 2 in Appendix I are the screenshots of the feedback videos. Moreover, to reinforce the understanding of the differences between expert-modeling and self-modeling, the researcher froze the video at a certain location during the creation of the feedback videos, added additional text comments, and took a screenshot to save the image. Presenting video feedback via still images facilitate visual memory of the information (see appendix I, example 3). After completing the production of the videos, the researcher uploaded the video materials and images to a private online folder via Google Drive and shared these videos with the parents.

Multiple Tests and Post-tests

The individual progress of the participants was tracked by multiple tests and two post-tests over the five-week span of the study. There were twelve tests during three weekly lessons. Each test was assigned the capital letter T with a number that indicated the week and a letter that indicated the sequence of the test (see table 2.2). The first lesson included three tests: T1/A, T1/B, and T1/C; the second lesson included five tests T2/A, T2/B, T2/C, T2/D, and T2/E; and the third lesson included four tests: T3/A, T3/B,
T3/C, and T3/D. All the participants recorded post-test I on the fourth week and post-test II on the fifth week.

The content of the twelve tests and two post-tests were same, except for the first test in the first lesson (T1/A). Participants were required to perform “Polka” hands separately and hands together with the tempo at which they felt comfortable. At T1/A, the participants were only asked to play the piece hands separately because the hands-together performance had not been introduced.

After three weekly lessons, no further live instruction was given. All the participants came to the research room to record post-test I and post-test II on the fourth and fifth week respectively. They were allowed to warm-up with C major 5-finger patterns prior to the post-tests. During the third week of practice prior to post-test I, video materials of the hands-together performance were available for all the participants to use; however, no video materials were available during the fourth week of practice prior to post-test II. The purpose of post-test II was to evaluate participants’ ability to retain their performance one week after removing video materials for home practice.

**Evaluation Process**

Five evaluation forms designed by the researcher were used in this study. Forms I and II were used for the pre-test (see appendix J). Forms III, IV, and V (see appendix K) were used for the twelve tests during the three lessons and for the two post-tests. All the test performances were then edited into an individual clip, assigned a number, and evaluated after the five-week span of the experiment. The researcher reviewed two clips for each test performance, including the side view and overhead view, and graded their
performances by using a seven-point Likert-type scale: 1) strongly disagree, 2) disagree, 3) slightly disagree, 4) neutral, 5) slightly agree, 6) agree, and 7) strongly agree.

Form I and Form II were designed for the pre-test. Form I was used to evaluate participants’ technique skills. Participants were asked to play C major 5-finger pattern twelve times and each time had a specific requirement in articulation (legato or staccato) and tempo (72bpm or 120bpm). The researcher used the form to generate twelve grades. Form II was used for evaluating participants’ sight-reading ability.

The forms for evaluating participants’ performance of playing “Polka” included two aspects: 1) motor performance, and 2) other aspects of performance (see appendix K). Motor performance were graded in the aspects of Hand/Finger Positions, Articulation, Hand Coordination (hands together only), and Tempo/Fluency; other aspects of performance were graded in the aspects of Pitch/Rhythm Accuracy, Dynamics, Balance (hands together only), and Artistry.

Form III, IV and V were used to evaluate participants’ motor performance and other aspects of performance when playing the piece “Polka”, respectively, left-hand alone, right-hand alone, and hands together. Prior to each test, participants were asked to play the tempo they felt comfortable with. Although a goal tempo of each week was indicated in the practice guideline, the researcher, at times, suggested a slower tempo that was more suitable for the participant.

The grade was calculated by the percentage of the points a participant received from each form. For example, if a participant received 42 out of 77 points for the L.H. motor performance in Form III, the percentage grade of the left-hand motor performance was 54.55%. In addition, the researcher graded the specific items in the motor
performance, including Hand/Finger Positions, Articulation, Hands Coordination (hands-together performance only), and Tempo/Fluency. If the participant received 13 out of 28 points for Hand/Finger Positions, the percentage grade of this particular skill was 46.43%.

This chapter explained the methodology of the study, including participant information, the teaching piece, technology setup, research structure and lesson plans, pre-tests, teaching segments and the use of technology, multiple tests and post-tests, practice guidance and assignment, video materials for home practice, and the evaluation process. Chapter 3 will present the results of the study, and Chapter 4 will provide a summary of this study and suggestions for future research.
CHAPTER 3
RESULTS

This chapter presents the results of using video modeling with video feedback for developing mid-to-late elementary piano students’ motor skills in learning a given piece. The researcher also evaluates if this method will benefit students’ other aspects of performance, including pitch/rhythm accuracy, dynamics, balance, and artistry, as well as the participants’ retention of skills between weeks.

The study involves the span of five weeks, including three weekly lessons and two post-tests on the fourth and fifth weeks respectively. The three weekly lessons combined the use of traditional instruction and a new method of video modeling. In the first lesson, all the participants learned the piece “Polka” hands separately and hands together under a traditional instructional method. In the second lesson, video modeling was used for the individual hand performance (the left hand and the right hand), followed by traditional instruction for the hands-together performance. The third lesson focused on the hands-together performance. The researcher began with a traditional method to address hand coordination issues, and then incorporated video modeling. Among seven teaching segments, four teaching segments followed the traditional method (live demonstration and verbal feedback), and three teaching segments incorporated video modeling (see table 3.1).
Table 3.1. Teaching segments

<table>
<thead>
<tr>
<th>Lesson Week No.</th>
<th>Teaching Segments</th>
<th>Teaching Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>P1/A</td>
<td>Traditional: L.H. and R.H. performance</td>
</tr>
<tr>
<td></td>
<td>P1/B</td>
<td>Traditional: H.T. performance</td>
</tr>
<tr>
<td>Week 2</td>
<td>P2/B</td>
<td>Video modeling: L.H. performance</td>
</tr>
<tr>
<td></td>
<td>P2/C</td>
<td>Video modeling: R.H. performance</td>
</tr>
<tr>
<td></td>
<td>P2/D</td>
<td>Traditional: H.T. performance</td>
</tr>
<tr>
<td>Week 3</td>
<td>P3/B</td>
<td>Traditional: H.T. performance</td>
</tr>
<tr>
<td></td>
<td>P3/C</td>
<td>Video modeling: H.T performance</td>
</tr>
</tbody>
</table>

Video modeling in the teaching segments varied between expert-modeling, self-modeling, and the comparison of the two models. The researcher guided the participants to observe expert-modeling at the original speed and in slow motion via the main display screen (iPad). They were then asked to replicate certain movements while they used two display screens (iPad and iPhone) as mirrors to monitor their performance captured by two GoPro cameras. The researcher provided prompt verbal feedback during this process to help them refine their movements. After a few practice repetitions, a short segment of the participants’ performance was recorded for self-modeling. The participants were guided to analyze their own performance and compare it to the expert’s performance. The term video feedback in this study refers to a process of analyzing self-modeling and/or comparing it to expert-modeling via motion analysis software. All the video modeling teaching segments incorporated video feedback.

Video modeling and video feedback was available during the second and third week of home practice (after the second and third lessons). The video materials included a video of expert-modeling and feedback video of participant’s self-modeling in contrast to expert-modeling. In the second week of practice, the participants were randomly assigned to receive the video materials for either the left-hand performance or the right-
hand performance. In the third week of practice, all the participants received the video materials for the hands-together performance while the video materials from the last week were removed. In the fourth week of practice, no video material was available to be used at home.

Participants’ individual progress was measured by multiple tests during three weekly lessons and two post-tests on the fourth and the fifth weeks respectively. Twelve tests were given during the first three lessons: T1/A, T1/B, and T1/C in week one; T2/A, T2/B, T2/C, T2/D, and T2/E in week two; and T3/A, T3/B, T3/C, and T3/D in week three. No instruction was given on the fourth and fifth week, and the participants only came to the research room to record post-test I in week four and post-test II in week five. For the test content, all the participants played “Polka” hands separately at T1/A, and then played hands separately and hands together for the remaining eleven tests and the two post-tests. Therefore, the grades of the left-hand and the right-hand performance at T1/A indicate the baseline performance of playing “Polka” hands separately, and the grades of the hands-together performance at T1/B indicate the baseline performance of playing hands together.

In this chapter, the researcher focuses on analyzing individual progress and score changes after video modeling with video feedback had been introduced during the three lessons. In addition, the researcher evaluates the effects of video materials for home practice and the performance retention between weeks.
Pre-test Results

A pre-test of technique and sight-reading was given at the beginning of the first lesson to evaluate participants’ technique and reading levels. The pre-test results in Appendix L show the grades for each test item. For the technique exercises, the participants played a C major 5-finger pattern twelve times in a row. Each repetition has different requirement for articulation (legato or staccato), hands (the left hand, the right hand, or hands together), and tempo (72bpm or 120bpm). Table 2.3 in chapter 2 presents the sequence. Twelve grades for each student were generated based on Form I: Technique Evaluation Form (see appendix J). The researcher calculated the average grades of six performances at 72bpm and six performances at 120bpm. Their average grades of playing the technique exercise at the two different tempi are presented in Figure 3.1 along with their sight-reading grades.

Figure 3.1. Pre-test results for technique and sight-reading.

The participants’ scores vary across the participant group and in the components of the pre-test. The blue columns indicate the average technique grades at 72bpm. Amy’s (70.62%), Charles’s (67.43%), Nicholas’s (69.22%), and Sophia’s (64.80%) grades are in
the range of 60%-70%, while Ella’s (43.58%) grade is 20% lower than others. The pink columns indicate the average technique grades at 120bpm. All their grades decline when they play at a faster tempo (see red columns in figure 3.1): Amy’s, Charles’s, Ella’s, Nicholas’s, and Sophia’s grades decline, respectively, 11.65%, 8.94%, 3.83%, 4.51%, 2.43% when playing at a faster tempo. Nicholas’s grade playing at 120bpm is 64.71%, the highest average grade among others, while Ella’s grade playing at 120bpm is 39.75%, approximately 20% lower than others. Amy’s grades show the largest difference playing at these two different tempi, while Sophia’s grades show the smallest difference. The most common features that caused the decline of the grades when playing at a faster tempo include increased wrist motions (bumpy motion or low wrist), difficulty in maintaining a proper hand position, increased tension, and improper fingers movements (flat and slippery fingers). Therefore, speed is an important variable to determine a student’s motor performance of a piece. Students are most likely to develop undesirable movement when they increase the performance tempo suddenly without guidance.

During the tests of this study, the researcher reminded participants to perform at a tempo at which they felt comfortable, to help prevent motor performance decline due to fast or unmanageable speeds.

The green columns show the sight-reading grades. Amy’s grade (69.39%) is the highest grade among others, followed by Sophia (59.18%), Charles (57.14%), Nicholas (48.98%), and Ella (42.86%). Amy showed ability to read all pitches accurately and was able to play fluently with relative minor hesitation. Sophia read all pitches correctly, but played with many hesitations and repetitions. Charles and Nicholas showed similar level of pitch recognition (less than half pitch errors), while Nicholas played with more
hesitation and repetition due to lack of preparation to new finger positions. Ella read the majority of notes incorrectly and demonstrated the least capacity to play with *legato* touch, although she kept moving forward as she read.

The results of the pre-test show each participant’s technique skill and reading ability prior to learning the new piece “Polka.” Form I for evaluating technique ability in the pre-test (see appendix J) includes Hand/Finger positions, Articulation, and Tempo/Fluency. These three aspects are also included in Forms III, IV and V for evaluating motor performance playing “Polka” (see appendix K). Therefore, the results of the technique pre-test directly relate to the level of each participant’s motor skill at the beginning of the study. Amy, Charles, Nicholas and Sophia demonstrated a similar technical level, while Ella showed a lower level of the technical skill than others. The sight-reading exercise (see chapter 2, figure 2.4) in the pre-test covers all the pitches included in the piece “Polka.” For the reading test, the participants showed varied levels of reading ability. Amy demonstrated the highest reading ability while Ella’s reading ability, especially in the aspect of pitch recognition, was the lowest among others. The sight-reading test predicted how quickly the participants could learn the piece “Polka” during the first lesson and how much assistance each participant would need for completing reading the piece during the first lesson.

**Performance Results**

The results of the research are presented in the following sequence: 1) left-hand performance, 2) right-hand performance, and 3) hands-together performance. Each section includes the graphs of each participant’s progress over the 5-week span of the
study, a description of the graphs, the tables showing score changes after video modeling teaching segments, and an analysis of the score changes.

This chapter includes analysis for four participants: Amy, Charles, Nicholas and Sophia. Over the five-week study, Ella showed less technical and reading capability to complete the task. She was not able to complete the tests of playing hands together. The other four participants showed similar performance levels and were able to complete the required task. Therefore, Ella’s performance results have been excluded from analysis. Her progress graphs in the left-hand and the right-hand performance are included in Appendix M as a reference for future studies.

**Left-Hand Performance Results**

The targeted left-hand motor skill in this piece is to play the musical phrases with proper *legato* touch and natural breath between phrases. Three aspects of motor performance (MP) are evaluated, including Hand/Finger positions, Articulation, and Tempo/Fluency. Video modeling of the researcher’s left-hand performance (expert-modeling) serves as the standard for this evaluation. In the video, the researcher demonstrates rounded and balanced hand posture, the use of fingertips, connected finger movements with smooth wrist motion, efficient movements at the position changes, gentle breathing wrist motions with proper release of fingers, and proper *tenuto* touch in the last measure. Other aspects of performance (OP) are also evaluated, including Pitch/Rhythm accuracy, Dynamics, and Artistry. For future analysis, the following abbreviations are utilized for analysis: MP stands for motor performance, and OP standards for other aspects of performance.
Figures 3.2 to 3.9 depict each participant’s scores for motor performance (MP) and other aspects of performance (OP) over the span of five-week study through the twelve tests and two post-tests. The scores of T1/A show each participant’s baseline performance of playing “Polka” hands separately.

In the data graphs, the vertical axis shows the grades of each test item, which are calculated by the percentage of points each participant received from the evaluation forms. 100% is the highest grade possible and 0% is the lowest grade possible. The horizontal axis lists the test numbers in chronological orders (T1/A, T1/B, etc.). The data graphs on the left side show the grades of each participant’s left-hand motor performance (MP), as well as the grades for three sub-items in MP, including 1) Hand/Finger position, 2) Articulation, and 3) Tempo/Fluency. The graphs in the right side show the test results of the left-hand motor performance and other aspects of performance (MP and OP). The graphs of the right-hand performance progress (Figure 3.10 through 3.17) and the hands-together performance progress (Figure 3.18 through 3.25) in this chapter follow this guideline.

Figure 3.2 and 3.3 show Amy’s progress for the left-hand performance. Her score in the left-hand baseline scores (T1/A) are 54.55% (MP) and 71.43% (OP). Amy’s left-hand MP and OP scores increase at T1/B and T1/C (total MP 64.94%, OP 77.14%) under traditional instruction during the first lesson. A noticeable increase of 7.8% in MP is shown at T1/C after a short self-practice period (P1/C). In the second week of lessons, her left-hand scores continuously improve at T2/A and T2/B, with a larger improvement of MP by 6.5% and OP by 8.57% at T2/B (total MP 74.03%, OP 85.71%), where video
Figure 3.2. Amy’s left-hand progress: MP.

Figure 3.3. Amy’s left-hand progress: MP and OP.

Figure 3.4. Charles’s left-hand progress: MP.

Figure 3.5. Charles’s left-hand progress: MP and OP.
Figure 3.6. Nicholas’ left-hand progress: MP.

Figure 3.7. Nicholas’ left-hand progress: MP and OP.

Figure 3.8. Sophia’s left-hand progress: MP.

Figure 3.9. Sophia’s left-hand progress: MP and OP.
modeling for the left-hand performance had been given prior to the test. Her left-hand scores at T2/B are the highest points among her other tests in the left hand. However, an immediate decline of 7.8% in the left-hand MP and 5.71% in OP is observed at T2/C (total MP 66.23%, OP 80%), where video modeling for the right-hand performance had been introduced prior to the test. A slight improvement in MP and OP is made at T2/E\(^1\) (total MP 67.53%, 82.86%). Amy’s left-hand scores in the third week of the study display an overall decline while the focus of the lesson had shifted to the hands-together performance. Her left-hand MP and OP scores reduce by, respectively, 3.89% and 5.72% at T3/A. A continuous decline of MP by 3.9% is observed at T3/C, where video modeling for the hands-together performance had been utilized prior to the test, although her OP score increases by 5.71%. By the end of the third lesson (T3/D), Amy’s left-hand MP score is maintained while her OP score drops slightly (total MP 59.74%, OP 77.14%). Her left-hand MP scores improve significantly by 9.09% at post-test I (total MP 68.83%, OP 80%), and a slight improvement is observed at post-test II (total MP 70.13%, OP 82.86%) in week five.

Figure 3.3 and 3.4 show Charles’s progress for the left-hand performance. His left-hand baseline scores (T1/A) are 38.96% (MP) and 57.14% (OP). Charles’s left-hand scores indicate minor progress during the first lesson under traditional instruction. His left-hand MP and OP scores at T1/C are 42.86% and 57.14%. In the second lesson, a minor decline of his left-hand score is shown at the beginning test T2/A (total MP 41.56%, OP 54.29%), followed by a sharp increase of 23.38% in the left-hand MP and

\(^1\) Due to an oversight by the researcher, Amy did not record the test T2/D. After the teaching segment T2/D, Amy practiced for two to three minutes on her own before recording the test T2/E.
22.85% in OP at T2/B (total MP 64.94%, OP 77.14%), where video modeling for the left-hand performance had been utilized prior to the test. His left-hand scores at T2/B are the highest score among all his other tests in the left hand. However, his left-hand MP and OP scores drop immediately by 10.39% and 14.28% respectively at T2/C (total MP 54.55%, OP 62.86%), where video modeling for the right-hand performance had been integrated prior to the test. In the third lesson, his left-hand MP and OP scores improve gradually through each test. Meanwhile, a marked increase of 14.29% in OP is shown at T3/B, where traditional instruction for the hands-together performance had been incorporated prior to the test. T3/D (total MP 59.74% and OP 77.14%) presents his best left-hand performance in the third week. Charles’s left-hand MP score improves by 5.2% while OP score declines by 2.85% at the post-test I in the fourth week (total MP 64.94%, OP 74.29%). A minor decline in the left-hand MP is observed at the post-test II in the fifth week (total MP 63.64%, OP 74.29%).

Figure 3.6 and 3.7 show Nicholas’s progress for the left-hand performance. His left-hand baseline scores are 45.45% (MP) and 62.86% (OP). Nicholas’s scores improve slightly during the first lesson, and his best performance of the lesson is presented at T1/C (total MP 48.05%, OP 68.57%). At the beginning of the lesson in week two, a significant improvement is made at T2/A with the increase of 12.99% in MP and 11.43% in OP (total MP 61.04%, OP 80%). During the second lesson, his left-hand MP scores improve substantially while his OP scores progress slightly. His left-hand MP score climbs quickly by 14.28% at T2/B (total MP 75.32%, OP 80%), where video modeling for the left-hand performance had been utilized prior to the test. His left-hand MP score continuously improves at T2/C by 6.5% (total MP 81.82%, OP 82.86%), where video
modeling for the right-hand performance had been incorporated prior to the test. His scores slightly drop at T2/D, but returns at T2/E (total MP 81.82%, OP 85.71%). In the third lesson, the MP and OP scores at T3/A drop by 7.79% and 8.57% respectively (total MP 74.03%, OP 77.14%). A minor improvement in the left hand is made at T3/B after receiving traditional instruction for the hands-together performance, and a larger improvement in MP by 6.5% and in OP by 8.57% is observed at T3/C (total MP 81.82%, OP 85.71%), where video modeling for the hands-together performance had been introduced prior to the test. There is a minor decline of the left-hand MP at T3/D (total MP 79.22%, OP 85.71%). Nicholas’s left-hand MP score increases slightly at post-test I in the fourth week (total MP 80.52%, OP 85.71%). His left-hand MP score continuously climbs to his highest one in the left hand at post-test II (total MP 83.12%, OP 82.86%) in the fifth week, but his OP score slightly drops.

Figure 3.8 and 3.9 show Sophia’s progress for the left-hand performance. Her left-hand baseline scores (T1/A) are 44.16% (MP) and 48.57% (OP). Sophia’s scores improve greatly at T1/B with the increase of 12.98% in MP and 14.29% in OP, but drop quickly at T1/C (total MP 46.75%, OP 57.14%) by 10.39% in MP and 5.72% in OP. At the beginning of the second lesson, Sophia’s left-hand MP improves significantly by 15.59% while her OP score is maintained at T2/A (total MP 62.34%, OP 57.14%). Her left-hand MP and OP continuously increase by 5.19% and 5.72% respectively at T2/B (total MP 67.53%, OP 62.86%), where video modeling for the left-hand performance had been introduced prior to the test. However, her left-hand scores decline immediately by 9.09% in MP and 5.72% in OP at T2/C (total MP 58.44%, OP 57.14%), where video modeling for the right-hand performance had been utilized prior to the test. After
traditional instruction for the hands-together performance (P2/D), Sophia’s left-hand performance greatly improves at the following test T2/D with the increase of 10.39% in MP and 5.72% in OP (total MP 68.83%, OP 62.86%). Her left-hand MP drops 2.6% at the following test T2/E (total MP 66.23%, OP 62.86%) after a short self-practice period. In the third lesson, a significant improvement in the left-hand MP by 7.8% and OP by 11.43% is made at T3/A (total MP 74.03%, OP 74.29%); however, a period of rapid decline in the left-hand performance is observed in the remaining tests during this lesson. The decline of the left-hand performance was probably due to her left-hand thumb injury.² Although her left-hand MP score slightly rises at T3/C, where video modeling for the hands-together performance had been utilized prior to the test, this does not change her overall decline of the performances in the third lesson. Her left-hand scores at the last test in week three (T3/D) are 61.04% in MP and 60% in OP, significantly lower (over 10%) than the scores at T3/A. Sophia’s scores improve substantially at post-test I with an increase of 11.69% in MP and 11.43% in OP (total MP 72.73%, OP 71.43%). A continuous minor progress is made at post-test II (total MP 74.03%, OP 71.43% OP).

**Left-Hand Score Changes after Video Modeling**

This section analyzes the left-hand score changes after receiving video modeling during the three weekly lessons, including P2/B (targeted for the left-hand skills) and P2/C (targeted for the right-hand skills) in the second week of lessons, and P3/C (targeted for the coordination of hands together) in the third week of lessons. The impacts on the left-hand performance after receiving left-hand video modeling is evaluated first,

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² Sophia came to the third lesson with a bandage on her left-hand thumb. She had a cracked thumbnail.
followed by the impacts on the left-hand performance after receiving right-hand video modeling and hands-together video modeling.

**Left-Hand Score Changes after Left-Hand Video Modeling**

Table 3.2 shows the left-hand score changes after video modeling for the left-hand performance had been incorporated. All participants’ left-hand MP scores significantly improve at T2/B. Three participants’ left-hand OP score improve while one’s OP score is maintained. The results show a significantly positive influence of left-hand video modeling on the left-hand performance.

**Table 3.2. Left-hand score changes after P2/B**

<table>
<thead>
<tr>
<th>Teaching Segment</th>
<th>Student Name</th>
<th>L.H. Score Changes between T2/A and T2/B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MP</td>
</tr>
<tr>
<td>P2/B: Video Modeling for L.H.</td>
<td>Amy</td>
<td>+ 6.5%</td>
</tr>
<tr>
<td></td>
<td>Charles</td>
<td>+23.38%</td>
</tr>
<tr>
<td></td>
<td>Nicholas</td>
<td>+14.28%</td>
</tr>
<tr>
<td></td>
<td>Sophia</td>
<td>+5.19%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+8.57%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+22.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+5.72%</td>
</tr>
</tbody>
</table>

Amy’s left-hand scores at T2/B are 74.03% (MP) and 85.71% (OP). These scores are the highest ones among all her other tests in the left hand. Her MP score increases by 6.5% and her OP increases by 8.57% from the previous test T2/A. At the left-hand baseline performance (T1/A), the researcher identified the following features of her performance. Amy was able to read the piece quickly and play at 80bpm with minor pitch and rhythmic errors. Her main problems included an unsupported and collapsed hand posture, flat fingers, occasionally low wrist position, improper finger movements, such as slipping fingers after pressing down the key, and lack of breathing between the phrases.

At the end of the first lesson (T1/C), she was able to lift the wrist to breathe; however, the
motion was inconsistent and her fingers did not leave the keys completely at the release. At T2/A, she retained the OP score with a slight improvement in MP by 2.59%. Although guided warm-up exercise at the beginning of the lesson helped improve the performance of Hand/Finger Position slightly, she was not able to maintain a good hand posture throughout her playing. With the guidance of video modeling in P2/B, there were immediate improvements in both Hand/Finger Positions by 14.28% and Articulation by 3.58% at T2/B. Amy showed more supported hand position throughout her playing. Her fingers stayed in their positions more securely without sliding, and her breathing motions became gentler with the complete release of fingers from the keys. For the OP score at T2/B, she performed more effectively in the aspects of Dynamics and Artistry.

Charles’s left-hand scores at T2/B are 64.94% (MP) and 77.14% (OP). Compared to test T2/A, a significant improvement in the left-hand MP by 23.38% and OP by 22.85% is shown after video modeling for the left-hand performance had been introduced. His left-hand improvement amount and scores at T2/B is the highest in comparison to the left-hand improvement in all his other tests. At the left-hand baseline performance (T1/A), the researcher identified the following features of his left-hand performance. Charles was able to begin with a rounded hand position, but it was difficult for him to maintain it. He tended to strike a key with a forced wrist motion downward. Although he was aware of taking breaths between the phrases, he tended to lift the hand high from the keyboard, causing delay of the next phrase. Charles had minimal improvement in week one. At the start of the lesson in week two, he performed less effectively at T2/A with the decrease of 1.3% in MP and 2.85% in OP. His wrist motion was bumpy, and he showed larger movements in breathing motions with an abrupt
release of the note at the end of the slur. His first finger did not prepare in advance for the new position in measure 6. After receiving video modeling for the left-hand performance (P2/B), there is a rapid increase in both left-hand MP and OP scores as shown in the Figure 3.4 and 3.5. His breathing motion became gentler as he lifted the hand a proper distance from the keyboard. In addition, his hand posture was slightly better and he was able to move his fingers in advance to new positions accurately in measure 6 and 7. He also demonstrated immediate improvement in all three aspects of OP.

Nicholas’s left-hand scores at T2/B are 75.32% (MP) and 80% (OP). His MP score increases by 14.28% while his OP score is maintained from the previous test T2/A. At the left-hand baseline performance (T1/A), the researcher noticed that he had difficulties in maintaining a rounded hand position. He played with bumpy wrist motions and a collapsed fifth finger, which caused uneveness in tone. Although he showed intention to take breaths between the phrases, he did not release the finger completely from the keys in breathing, and the breathing motions were not smooth and consistent. At T2/A, Nicholas improved significantly with the increase of 12.99% in MP and 11.43% in OP. The main improvement was shown in Hand/Finger Positions by 17.86%; however, he was not able to breathe between the phrases. After video modeling for the left-hand performance was utilized, Nicholas improved largely in the aspects of Hand/Finger Positions by 21.42% and Articulation by 28.57%. He played with rounded hand positions, firm and curved fingers, and demonstrated gentle breathing motions, and more prepared hand positions. However, unnecessary tension was developing in his shoulder and hands after receiving video modeling for the left-hand performance. The tension was probably from his intention to match the expert’s model by over-controlling his hand
movements. In terms of the left-hand OP score at T2/B, he maintained the same score from T2/A: he improved Artistry in exchange with a slight lower grade in Pitch/Rhythm Accuracy.

Sophia’s left-hand scores at T2/B are 67.53% (MP) and 62.86% (OP). Her MP and OP scores are, respectively, 5.19% and 5.72% higher than the previous test T2/A. At the left-hand baseline performance (T1/A), the researcher discovered the following features of her playing. She showed a flat left-hand posture with little space between the hands and keyboard. She played with bumpy wrist motions and a collapsed thumb. Although she took breaths between the phrases, the motions were inconsistent. During the first lesson, Sophia’s performance improved greatly at T1/B. This improvement was mainly shown in the aspects of Tempo/Fluency and Pitch/Rhythm Accuracy. However, her performance declined quickly at the following test T1/C. In the first test of the second lesson (T2/A), Sophia improved significantly in her left-hand MP score by 15.59% while maintaining the OP score. This large improvement in MP was shown in the aspects of Hand/Finger Position by 17.86%, Articulation by 10.72%, and Tempo/Fluency by 19.05%. Sophia continuously improved her left-hand MP by 5.19% and OP by 5.72% after video modeling for the left-hand performance was introduced (P2/B). Although she played at a slightly slower tempo, there is a 7.14% increase in Hand/Finger Positions and a 10.71% increase in Articulation. She demonstrated gentle breathing motions in a more consistent manner, and her hand lifted to a proper distance from the keyboard. She was able to move the thumb to the new position in advance in measure 6, and move back to C position in measure 7 by taking a gentle breath. The sound created by proper breathing movements helped her receive a higher Artistry score in OP.
Left-Hand Score Changes after Right-Hand Video Modeling

P2/C was the teaching segment after P2/B during the second lesson. The teaching segment P2/C incorporated video modeling for the right-hand performance while the left-hand performance was not exposed in the video. Table 3.3 shows the score changes of the left-hand performance after right-hand video modeling. The scores demonstrate how technical focus upon the right hand impacts the security and ease of the left-hand performance.

Table 3.3. Left-hand score changes after P2/C

<table>
<thead>
<tr>
<th>Teaching Segment</th>
<th>Student Name</th>
<th>L.H. Score Changes Between T2/B to T2/C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OP</td>
</tr>
<tr>
<td>P2/C: Video Modeling for R.H.</td>
<td>Amy</td>
<td>-7.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-5.71%</td>
</tr>
<tr>
<td></td>
<td>Charles</td>
<td>-10.39%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-14.28%</td>
</tr>
<tr>
<td></td>
<td>Nicholas</td>
<td>+6.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+2.86%</td>
</tr>
<tr>
<td></td>
<td>Sophia</td>
<td>-9.09%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-5.72%</td>
</tr>
</tbody>
</table>

In contrast to a marked improvement in the left-hand scores at T2/B, all participants’ scores—except for Nicholas—for the left-hand performance drop quickly at T2/C, where video modeling had shifted to the right-hand performance. Under the MP categories, Hand/Finger Positions and Articulation are the major cause of score declines: Amy’s scores drop 14.28% and 7.15% respectively; Charles’s scores drop 10.72% and 14.28% respectively; and Sophia’s scores drop 14.29% and 7.14% respectively in the above two aspects. In comparison to the ideal gentle breathing motions at T2/B, Amy developed a larger movement by lifting the left hand higher from the keyboard. Charles went back to the habit of breathing abruptly as he did at T2/A. Sophia was not able to move her thumb to the new position in advance as she demonstrated at T2/B, and she
positioned her wrist high as she played. Different than the other three, Nicholas continued
to improve his left-hand performance with the increase of 3.58% in Hand/Finger
Positions, 3.57% in Articulation, and 14.28% in Tempo/Fluency.

*Left-Hand Score Changes after Hands-Together Video Modeling*

Table 3.4 shows the score changes of the left-hand performance after video
modeling for the hands-together performance (P3/C) had been introduced in the third
lesson. P3/C primarily addressed hand coordination issues for the hands-together
performance. Meanwhile, the left-hand and the right-hand performance were also
displayed. The majority of the participants’ MP and OP scores in the left hand improve at
T3/C after hands-together video modeling, although the improvement is less noticeable
than the left-hand improvement at T2/B after left-hand video modeling.

Table 3.4. Left-hand score changes after P3/C

<table>
<thead>
<tr>
<th>Teaching Segment</th>
<th>Student Name</th>
<th>L.H. Score Changes Between T3/B to T3/C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MP</td>
</tr>
<tr>
<td>P3/C: Video Modeling for H.T.</td>
<td>Amy</td>
<td>-3.9%</td>
</tr>
<tr>
<td></td>
<td>Charles</td>
<td>+2.6%</td>
</tr>
<tr>
<td></td>
<td>Nicholas</td>
<td>+6.5%</td>
</tr>
<tr>
<td></td>
<td>Sophia</td>
<td>+3.89%</td>
</tr>
</tbody>
</table>

Nicholas’s score presents the most positive increase in the left hand than other
three participants after hands-together video modeling. Following traditional instruction
of the hands-together performance (P3/B), Nicholas’s left-hand MP increases by 1.29%
while his OP score is maintained at T3/B. A larger improvement in the left hand is shown
at T3/C with the increase of 6.5% in MP and 8.57% in OP after receiving video modeling
for the hands-together performance (P3/C). The researcher identified the following
improvements in the left hand at T3/C: his fingers were more securely placed on the corresponding keys; he played with curved fingers throughout the piece; his wrist motion was less bumpy; and his breathing motions were more fluent.

The other three participants’ left-hand scores show relatively minor changes at T3/C. Amy’s left-hand MP score decreases by 2.6% at T3/C. This was primarily because of a slower performance tempo at T3/C than the previous test T3/B. However, her left-hand OP score increases by 5.71% at T3/C. The score increase occurs in the aspect of Dynamics. She was able to play with more dynamic changes in the left hand (crescendo and decrescendo) from measure 5 to 8. Charles’s left-hand MP improves by 2.6% and his OP improves by 2.86% at T3/C. The MP score improves is reflected in better Hand/Finger Positions. In comparison to his left-hand performance at T3/B, he played with more curved fingers and demonstrated more advanced preparation for new finger positions. The improvement in advanced finger preparation also positively affected the score of pitch accuracy in OP. Sophia’s left-hand MP increases 3.89% while her OP drops by 2.86%. The main improvement at T3/C is shown in the aspect of Hand/Finger Positions. She demonstrated more rounded and balanced hand positions at T3/C than the previous performance at T3/B. The decline of her OP score is caused by a slight decrease in rhythm accuracy.

**Right-Hand Performance Results**

The targeted right-hand motor skill in this piece is playing harmonic intervals with crisp and light *staccato* touch. This motor skill is evaluated in three aspects: Hand/Finger Positions, Articulation, and Tempo/Fluency. Expert-modeling of the right-
hand performance demonstrates rounded and balanced hand posture, the use of fingertips, direct and quick finger actions in staccato, efficient movements at the position changes, stable wrist motions, smooth connection of two-note slurs, and a tenuto note in the end. Other aspects of performance include Pitch/Rhythm Accuracy, Dynamics, and Artistry. The expert’s model serves as the standard for this evaluation. Figure 3.10 to 3.17 illustrates each participant’s progress over the span of this five-week study through twelve tests and two post-tests. The scores of T1/A indicate each participant’s baseline performance of playing “Polka” with the right-hand alone.

Figure 3.10 and 3.11 show Amy’s progress for the right-hand performance. Her right-hand baseline scores (T1/A) are 70.13% (MP) and 65.71% (OP). Amy’s MP and OP scores are maintained at T1/B, but her MP reduces by 7.9% at T1/C (total MP 62.34%, OP, 65.71%). In the second lesson, a slight improvement is shown at T2/A with the increase of 3.89% in MP and 5.72% in OP (total MP 66.23%, OP 71.43%). Her right-hand MP score increases by 2.6% while OP declines by 5.72% at T2/B, where video modeling for the left-hand performance had been provided prior to the test. There is no score change in the right hand at the following test T2/C, where video modeling for the right hand had been introduced prior to the test. After traditional instruction of hands together (P2/D) and a short self-practice period (P2/E),³ Amy’s right-hand performance improved significantly; the score increases 9.09% in MP and 8.58% in OP at T2/E (total MP 77.92%, OP 74.29%). At the beginning of the third lesson (T3/A), Amy’s right-hand MP score slightly improves by 1.3% while her OP declines by 5.72%. Her scores in the remaining tests of the third lesson display minor improvement in either right-hand MP or

³ Amy did not record the test T2/D due to an oversight by the researcher.
Figure 3.10. Amy’s right-hand progress: MP.

Figure 3.11. Amy’s right-hand progress: MP and OP.

Figure 3.12. Charles’ right-hand progress: MP.

Figure 3.13. Charles’ right-hand progress: MP and OP.
Figure 3.14. Nicholas’s right-hand progress: MP.

Figure 3.15. Nicholas’s right-hand progress: MP and OP.

Figure 3.16. Sophia’s right-hand progress: MP.

Figure 3.17. Sophia’s right-hand progress: MP and OP.
OP, and the best score occurs in week three at T3/D (total MP 83.12%, OP 71.43%). Her right-hand MP score is maintained at post-test I in the fourth week while her OP score improves by 2.86% (total MP 83.12%, OP 74.29%). A minor decline of 2.6% in the right hand is shown at post-test II in the fifth week (total MP 80.52%, OP 74.29%).

Figure 3.12 and 3.13 show Charles’s progress for the right-hand performance. His right-hand baseline scores (T1/A) are 38.96% (MP) and 31.43% (OP). In the first lesson, an evident improvement in the right hand is made at T1/B with the increase of 16.88% in MP and 17.14% in OP at T1/B. His score in MP drops slightly by 1.29% at T1/C (total MP 54.55%, OP 48.57%). At the beginning of the second lesson, Charles’s right-hand scores increase significantly by 10.39% in MP and 11.43% in OP at T2/A. However, a rapid decline in the right-hand MP by 12.99% and in OP by 11.43% is observed at T2/B (total MP 51.95%, OP 48.57%), where video modeling for the left-hand performance had been utilized prior to the test. To the contrary, a marked improvement in the right hand is made at T2/C, where video modeling had shifted to the right-hand performance. Charles’s right-hand scores climb sharply by 20.78% in MP and 17.14% in OP at T2/C (total MP 72.73%, OP 65.71%). At the first test of the third lesson (T3/A), Charles’s right-hand performance shows a decline of 6.5% in MP. Improvements in the right-hand MP are shown in the following two tests T3/B (increase 6.5%) and T3/C (increase 3.89%) although his OP score slightly drops. His right-hand MP score at T3/C (76.62%) is the highest grade among all his other tests in the right hand. An immediate decline of 7.79% in right-hand MP is observed at T3/D (total MP 68.83%, OP 62.86%) after a short self-practice period. Charles’s right-hand MP increases by 5.2% while his OP is maintained at post-test I (total MP 74.03%, OP 62.86%) in the fourth week. His
performance at post-test II (total MP 72.73%, OP 62.86%) in the fifth week shows a slight decline in MP with no change in OP score.

Figure 3.14 and 3.15 show Nicholas’s progress for the right-hand performance. His right-hand baseline scores (T1/A) are 57.14% (MP) and 60% (OP). His performance improves through each week and reaches his highest scores in the right hand at post-test II in the fifth week. In the first lesson, his scores improve slightly at T1/B, but drop immediately at T1/C with the decrease of 5.19% in MP and 17.15% in OP. In the second lesson, his scores increase by 6.49% in MP and 8.58% in OP at T2/A. An opposite result in MP and OP is shown at T2/B with a decrease of 5.2% in the right-hand MP and an increase of 2.85% in OP, where video modeling for the left-hand performance had been integrated prior to the test. To the contrary, a marked improvement in the right-hand MP by 10.39% and in OP by 5.72% is made at the following test T2/C (total MP 66.23%, OP 62.86%), where video modeling for the right-hand performance had been given prior to the test. Nicholas’s right-hand MP scores continuously improve at T2/D (increase 2.6%) and T2/E (increase 8.49%), while a mix of increase and decline is shown in OP. At the first test of the third lesson (T3/A), Nicholas’s OP score improves largely by 14.29% with a minor increase of 0.6% in MP. Another significant improvement is observed at T3/C with an increase of 10.39% in MP and 5.72% in OP, where video modeling for hands together had been incorporated prior to the test. His scores decline by 5.2% in MP and 5.72% in OP at T3/D (total MP 76.62%, OP 77.14%) after a short self-practice period. His scores gain slightly at post-test I (total MP 79.22%, OP 80%) in the fourth week. More evident improvement is shown at post-test II (total MP 87.01%, OP 85.71%) in the fourth week.
Figure 3.16 and 3.17 show Sophia’s progress for the right-hand performance. Her right-hand baseline scores (T1/A) are 51.95% (MP) and 60% (OP). In the first lesson, an improvement of 6.49% in MP is made at T1/B, while her OP score drops by 2.86% at T1/B. Her right-hand OP climbs by 5.72% at T1/C (total MP 58.44%, OP 62.86%) while the MP score is maintained. At the first test of the second lesson, her MP score improves by 6.5% with no change of the OP score at T2/A (total MP 64.94%, OP 62.86%). However, there is an immediate decline of the right-hand MP by 6.5% and OP by 5.72% at T2/B (total MP 58.54%, OP 57.14%), where video modeling for the left hand had been given prior to the test. To the contrary, after receiving video modeling for the right-hand performance (P2/C) in the following teaching segment, her scores largely improve by 9.09% in MP and 11.43% in OP at T2/C (total MP 67.53%, OP 68.57%). Her performance declines gradually in the remaining tests of the second lesson—T2/D and T2/E (total MP 62.34%, OP 65.71%). In the third lesson, Sophia’s scores improve at the first test of the lesson (T3/A) with an increase of 6.49% in MP and 2.86% in OP; however, no further improvements are shown in the remaining tests of the lesson, and there is a tendency for minor decline from T3/B to T3/D (total MP 66.23%, OP 62.86%). Sophia’s right-hand performance improves greatly at post-test I (total MP 71.43%, OP 77.14%) in the fourth week with an increase of 5.2% in MP and 14.28% in OP. However, her right-hand performance declines at post test II (total MP 68.83%, OP 68.57%) in the fifth week with the decrease of 2.6% in MP and 8.57% in OP.
Right-Hand Score Changes after Video Modeling

This section analyzes the right-hand score changes after receiving video modeling teaching segments during the three weekly lessons, including P2/B (targeted for the left-hand skills) and P2/C (targeted for the right-hand skills) in the second week of lessons, and P3/C (targeted for the coordination of hands together) in the third week of lessons. The impacts on the right-hand performance after right-hand video modeling is evaluated first, followed by the impacts on the right-hand performance after left-hand video modeling and hands-together video modeling.

Right-Hand Score Changes after Right-Hand Video Modeling

Table 3.5 shows the right-hand score changes after video modeling for the right-hand performance had been introduced. The results show that three participants significantly improve both their right-hand MP and OP scores while one participant has no change in scores.

Table 3.5. Right-hand score changes after P2/C

<table>
<thead>
<tr>
<th>Teaching Segment</th>
<th>Student Name</th>
<th>R.H. Score Changes Between T2/B to T2/C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MP</td>
</tr>
<tr>
<td>P2/C: Video Modeling for R.H.</td>
<td>Amy</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Charles</td>
<td>+20.78%</td>
</tr>
<tr>
<td></td>
<td>Nicholas</td>
<td>+10.39%</td>
</tr>
<tr>
<td></td>
<td>Sophia</td>
<td>+9.09%</td>
</tr>
</tbody>
</table>

Amy’s right-hand scores at T2/C are 68.83% (MP) and 65.71% (OP). There is no score change in the right hand at T2/C after receiving video modeling for the right-hand performance. At the right-hand baseline performance (T1/A), Amy was able to play with great fluency and her *staccato* was crisp and even. The issues that needed to be addressed
included collapsed fingers, slight hesitation to new positions, and collapsed wrist at the initiation of the *staccato* touch. She maintained her right-hand performance at T1/B, but played less well at T1/C with a decline of 7.79% in MP. The main cause of the decline was increased hesitation to new positions. Her right-hand performance slightly improved at the first test of week two and showed continuous improvement in Tempo/Fluency throughout the remaining tests of the lesson. However, in terms of overall grades in the right-hand MP and OP, there was no noticeable progress at T2/B, where video modeling for the left-hand performance was given prior to the test, as well as at T2/C, where video modeling for the right-hand performance was introduced prior to the test. Although there was no right-hand score change after the video treatment for the right hand at T2/C, several changes in movements were observed. As mentioned earlier in her *staccato* motion, Amy tended to lower the wrist at the initiation of the *staccato*. At T2/C, she tried to control and adjust her right-hand wrist position as she played. This adjustment during the test may have caused the inconsistency and minor hesitation in her movements. It is notable that Amy significantly improved her performance at T2/E with the increase of 9.09% in MP and 8.58% in OP. Prior to the test, the teacher worked with her hand coordination and balance/dynamics at the teaching segment P2/D, and then a short practice period at P2/E was given. At T2/E, Amy showed more direct and efficient movement of moving her right-hand fingers to the new positions, and smooth connection for the two-note slur in measure 8. She had slight improvement in *staccato* motion because she kept her fingers a proper distance from the keyboard once she jumped up, although she still lowered the wrist at the initiation of *staccato*. Few aspects of the above

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4 Amy did not record the test T2/D due to an oversight by the researcher.
improvements, such as efficient finger movements to the new positions and the \textit{staccato} motions, were only addressed in the video modeling teaching segment P2/C.

Charles’s right-hand scores at T2/C are 72.73\% (MP) and 65.71\% (OP). After receiving video modeling for the right-hand performance, Charles’s right-hand MP increases by 20.78\% and OP increases by 17.14\% at T2/C. This shows the highest improvement amount among all his tests in the right hand. At his right-hand baseline performance (T1/A), the researcher noticed that he pressed the keys forcefully and failed to demonstrate crisp \textit{staccato} touch with proper release of keys. Although a slight improvement in \textit{staccato} was shown in the following tests (T1/B and T1/C), he released the keys inconsistently with some improper gestures. For instance, he struck the keys heavily, and curved his fingers immediately at the release of \textit{staccato} touch while he lifted the wrist high and moved his hand away from the keyboard. Consequently, he lost a balanced hand posture and security in positions when his right-hand was in the air. In the second lesson, Charles improved significantly at T2/A with an increase of 10.39\% in his right-hand MP and 11.43\% in OP. He could play \textit{staccato} with more ease and kept his hand close to the keyboard, although the above improper gestures in \textit{staccato} were still present. An extra wrist motion was noticed before he struck the keys in \textit{staccato}. He performed less successfully at T2/B with the decrease of 12.99\% in MP and 11.43\% in OP at T2/B, where video modeling for the left-hand performance was utilized prior to the test. The main cause of the significant decline at T2/B was that he failed to play with \textit{staccato} touch and failed to release the keys. At T2/C, where video modeling for the right-hand performance (P2/C) had been integrated prior to the test, Charles improved his \textit{staccato} touch with more consistent release of fingers, more controlled hand and finger
motions, and less unnecessary movements. In addition, it was the first time he was able to connect the last two notes in the right hand in measure 8. In terms of OP at T2/C, he was able to play *staccato* with lighter touch (Dynamics) and with more proper character (Artistry). These factors contribute to a large increase in OP score. After the marked improvement at T2/C, Charles maintained his right-hand performance level on the next test T2/D.\(^5\)

Nicholas’s right-hand scores at T2/C are 66.23% (MP) and 62.86% (OP). After video modeling for the right hand had been introduced, his right-hand MP increases by 10.39% and OP increases by 5.72% at T2/C. The researcher noticed a few flaws in motions at his right-hand baseline performance (T1/A). He showed inconsistent wrist motions in *staccato* touch. He tended to lift his wrist up and drop it immediately at the initiation of *staccato* touch, and occasionally positioned his wrist lower than the keyboard before playing. He was not able to connect the two-note slur in measure 8 in the right hand. Although his wrist motion in *staccato* became more stable at T2/B, he tended to lock his wrist in a lower position and open his hands towards the air. After receiving video modeling for the right hand (P2/C), Nicholas showed many aspects of positive changes in motions at T2/C. His wrist position was slightly better. He showed more direct up and down actions in *staccato*, although his movements still lacked a natural flow. He demonstrated more efficient movement by directly moving his fingers to the next new position at the moment his right hand bounced up in the air. In addition, he successfully connected the last two harmonic intervals in the right hand, although he still played with flat fingers 2 and finger 4 for the last harmonic interval. In terms of OP at T2/C, he

\(^5\) During the second lesson, Charles could not complete the last portion of the lesson due to the time limits, including P2/E (Practice Period) and test T2/E.
improved pitch accuracy. Nicholas maintained his skill and continuously improved his right-hand MP performance with greater tempo and fluency at T2/D after traditional instruction for the hands-together performance, as well as at T2/E after a short self-practice period.

Sophia’s right-hand scores at T2/C are 67.53% (MP) and 68.57% (OP). Her MP score increases by 9.09% and OP score increases by 11.43% after video modeling for the right hand was given. The increased amount in MP shows the highest improvement amount among all her tests in the right-hand MP. At the baseline (T1/A), the researcher noticed that her *staccato* was not crisp, and there was an extra downward motion in the wrist each time before she struck the keys. She was able to connect last two notes in the right hand in measure 8. With the increased tempo she performed at T1/B and T1/C, her wrist motions became bumpier, and she was not able to connect the last two notes in measure 8 as she showed in the previous test T1/A. In the second lesson, except for being able to play at a greater tempo and fluency at T2/B, her *staccato* motion was not improved. After receiving video modeling for the right hand (P2/C), Sophia showed several positive changes in the *staccato* touch. She had more prompt motions in *staccato*, which facilitated crisp sound effects. Her *staccato* motions became more efficient as she kept her hand close to the keyboard and her wrist motion was less active and bumpy. She also tried to move her fingers to the new position directly at the moment her right hand bounced up to the air. Moreover, she connected the last two notes with proper down-up motions. However, theses improved aspects were not maintained in the remaining tests (T2/D and T2/E) of week two. There was a tendency to return to the old habit of bumpy wrist motions. She also failed to connect the last two harmonic intervals in measure 8 at
T2/D and T2/E as she demonstrated at T2/C. In terms of OP at T2/C, her improvement was shown in the aspect of Pitch/Rhythm Accuracy.

Right-Hand Score Changes after Left-Hand Video Modeling

Teaching segment P2/B incorporated video modeling for the left-hand performance, which focused on legato touch and breathing motions. The right-hand performance that required a different articulation (staccato) was not presented at P2/B. Although the content of video modeling at P2/B seems irrelevant to the right-hand skills, the researcher investigates the impacts of showing a good model of one hand on another hand’s performance. Table 3.6 shows the score changes of the right-hand performance after video modeling for the left hand had been introduced.

Table 3.6. Right-hand score changes after P2/B

<table>
<thead>
<tr>
<th>Teaching Segment</th>
<th>Student Name</th>
<th>R.H. Score Changes Between T2/A to T2/B</th>
<th>MP</th>
<th>OP</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2/B: Video Modeling for L.H.</td>
<td>Amy</td>
<td>+2.6%</td>
<td>-5.72%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Charles</td>
<td>-12.99%</td>
<td>-11.43%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nicholas</td>
<td>-5.2%</td>
<td>+2.85%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sophia</td>
<td>-6.5%</td>
<td>-5.72%</td>
<td></td>
</tr>
</tbody>
</table>

There is a mixed result of positive and negative effect on the right-hand performance after participants observed video modeling for the left-hand performance, and the majority of score changes are negative. Charles’s right-hand scores dropped the most among others because he failed to play staccato touch at T2/B. Another time he did not demonstrate staccato touch was at the baseline performance. Sophia performed less well at T2/B with the decrease of the right-hand MP by 6.5% and OP by 5.72%, which
was one of the largest declines in her right-hand performance. The decline was mainly shown in the aspects of Articulation and Pitch/Rhythm Accuracy.

Amy’s and Nicholas’s MP and OP scores are connected inversely to one another. Amy’s right-hand performance improved slightly in the aspects of Hand/Finger Positions and Tempo/Fluency in MP, but declined mildly in the aspects of Pitch/Rhythm Accuracy and Artistry in OP. Nicholas’s right-hand performance showed small decline in the aspects of Hand/Finger Positions with an insignificant regress in the aspects of Articulation in MP, to the contrary, he improved in Artistry slightly in OP.

*Right-Hand Score Changes after Hands-Together Video Modeling*

Table 3.7 shows the score changes of the right-hand performance after video modeling for the hands-together performance (P3/C) had been introduced. Although the right-hand performance was displayed at P3/C, the primary focus of this video treatment was on the coordination issues of the hands-together performance. The scores demonstrate how technical focus upon the hands-together performance influences the right-hand alone performance.

Table 3.7. Right-hand score changes after P3/C

<table>
<thead>
<tr>
<th>Teaching Segment</th>
<th>Student Name</th>
<th>R.H. Score Changes Between T3/B to T3/C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MP</td>
</tr>
<tr>
<td>P3/C: Video Modeling for H.T.</td>
<td>Amy</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Charles</td>
<td>+3.89%</td>
</tr>
<tr>
<td></td>
<td>Nicholas</td>
<td>+10.39%</td>
</tr>
<tr>
<td></td>
<td>Sophia</td>
<td>0%</td>
</tr>
</tbody>
</table>

The results show general positive changes in the right-hand performance at T3/C, where video modeling for the hands-together performance had been used prior to the test.
Nicholas’s right-hand scores improve significantly in comparison to a relatively small improvement in Amy’s and Charles’s right-hand scores, while Sophia’s right-hand OP score declines. As a reference for the following analysis, there were two consecutive teaching segments that addressed hand coordination issues during the third lesson: P3/B applied traditional instruction, and P3/C incorporated video modeling and prioritized the issues that could not be resolved in P3/B.

Amy had minor progress in the right-hand performance with an increase of 1.3% in the right-hand MP at T3/B (after P3/B) and an increase of 2.86% in the right-hand OP at T3/C (after P3/C). This small progress in the right hand continued to the next test T3/D after a short self-practice period.

Charles showed slight improvement in the right-hand MP after both teaching segments for hands together while his OP regressed. After traditional instruction at P3/B, Charles’s right-hand MP increases by 6.5% at T3/B, which is mainly shown in the aspects of Articulation and Tempo/Fluency. After hands-together video modeling at P3/C, his right-hand MP continuously increases by 3.89% at T3/C, which is mainly shown in Hand/Finger Positions. However, Charles’s right-hand performance declines by 7.79% in MP at the following test (T3/D) after a short self-practice because his performance in Hand/Finger Positions regressed.

Nicholas’s right-hand OP is 2.85% higher while his MP drops by 6.49% at T3/B after traditional instruction for hands together. He greatly improved his right-hand performance with the increase of 10.39% in MP and 5.72% in OP at T3/C, where video modeling for the hands-together performance had been utilized prior to the test. The improvement was evident in all three aspects (Hand/Finger Positions, Articulation, and
Tempo/Fluency) of his MP, and in the aspects of Pitch/Rhythm Accuracy and Dynamics in OP. However, his right-hand performance regressed at T3/D with the decline of 5.2% in MP and 5.72% in OP.

Contrary to other participants, Sophia’s right-hand scores do not improve after both teaching segments for hands together. Her right-hand MP slightly declines at T3/B by 2.6% after traditional instruction. Although she was able to connect the right-hand two-note slur in measure 8 more successfully at T3/B, her scores in Hand/Finger Positions decline due to bumpier wrist motions. After video modeling for hands together was integrated, her right-hand score in Hand/Finger Positions improves slightly in exchange of a lower score in Articulation at T3/C. Her right-hand OP score is lowered by 5.71% at T3/C due to the decline of Pitch/Rhythm Accuracy and Dynamics.

**Hands-Together Performance Results**

The targeted motor skill for playing hands together in this piece is to coordinate properly between the left-hand *legato* motion and the right-hand *staccato* motion. Four aspects of motor performance are evaluated, including Hand/Finger Positions, Articulation, Hand Coordination, and Tempo/Fluency. Expert-modeling of hands together performance serves as the standard for this evaluation. In the video, the researcher demonstrates rounded and balanced hand posture, the proper use of fingertips, left-hand connected finger movements with smooth wrist motion, right-hand crisp and light *staccato* touch, efficient movement at the position changes, left-hand gentle breathing motion against right-hand quick *staccato* action, proper coordination in measure 8 (two-note slur in the right hand). The researcher also evaluates other aspects of
performance, including Pitch/Rhythm Accuracy, Balance, and Artistry. Figures 3.18 to 3.25 show each participant’s progress over the span of this five-week study through twelve tests and two post-tests. Participants’ baseline performance of hands together is the score received at T1/B, where their hands-together performances had been recorded for the first time.

Table 3.18 to 3.25 are the data graphs that depict each participant’s progress of playing hands together over the five-week span of the study. Hands-together motor performance (MP) includes four sub-items for evaluation: Hand/Finger Positions, Articulation, Hand Coordination, and Tempo/Fluency. Other aspects of performance (OP) in hands together include three sub-items for evaluation: Pitch/Rhythm Accuracy, Balance/Dynamics, and Artistry. The first test of hands-together performance was recorded at T1/B.

Figure 3.18 and 3.19 shows Amy’s progress of playing hands together. Her hands-together baseline scores (T1/B) are 52.10% (MP) and 68.57% (OP). Her hands-together MP score improves by 5.88% while OP score drops by 2.86% at T1/C (total MP 57.98%, OP 65.71%) after a short self-practice period. In the first test of the second lesson (T2/A), her hands-together MP declines slightly by 3.36% while maintaining the OP score. A continuous improvement in the hands-together performance is observed throughout the remainder of tests in the second lesson. Her hands-together scores increase by 4.2% in MP and 2.86% in OP at T2/B, where video modeling for the left-hand performance had been given prior to the test. Her hands-together MP improves by
Figure 3.18 Amy’s hands-together progress: MP.

Figure 3.19. Amy’s hands-together progress: MP and OP.

Figure 3.20. Charles’s hands-together progress: MP.

Figure 3.21. Charles’s hands-together progress: MP and OP.
Figure 3.22. Nicholas’s hands-together progress: MP.

Figure 3.23. Nicholas’s hands-together progress: MP and OP.

Figure 3.24. Sophia’s hands-together progress: MP.

Figure 3.25. Sophia’s hands-together progress: MP and OP.
5.05% while there is no change in OP score at T2/C, where video modeling for the right-hand performance had been used prior to the test. Minimal improvements of 1.68% in MP and 2.86% in OP are presented at T2/E (total MP 65.55%, OP 71.43%). In the first test of the third lesson, Amy’s hands-together scores decline by 3.37% in MP and 5.72% in OP at T3/A (total MP 62.18%, OP 65.71%). Her hands-together MP increases by 2.53% and OP increases by 5.72% at T3/B after receiving tradition instruction for the hands-together performance. A continuous gain of 2.52% in MP and 8.57% in OP is observed at T3/C (total MP 67.23%, OP 80%), where video modeling for the hands-together performance had been integrated prior to the test. Her hands-together OP score at T3/C presents her highest OP score among all her other hands-together tests. However, her scores decline immediately at T3/D (total MP 65.55, OP 68.57%) with a marked decrease of 11.43% in OP after a short self-practice period. Amy’s hands-together scores at post-test I in the fourth week are 72.27% (MP) and 65.71% (OP). Her MP increases by 6.72% as the OP score continuously drops by 2.86%. Amy’s MP and OP scores improve at post-test II (total, MP 74.79%, OP 74.29%) in the fifth week with the increase of 2.52% in MP and 8.58% in OP.

Figure 3.20 and 3.21 shows Charles’s progress of playing hands together. His hands-together baseline scores (T2/B) are 42.02% (MP) and 40% (OP). In the first lesson, a minor decline is shown at T1/C (total MP 38.66%, OP 37.14%). In the second lesson, his hands-together MP improves significantly by 10.08% and OP by 8.57% at T2/A (total MP 48.74%, OP 45.71%). Charles’s hands-together scores show minimal progress throughout the remaining tests of the second lesson. His hands-together scores increase by 1.68% in MP and 2.86% in OP at T2/B, where video modeling for the left hand had
been incorporated prior to the test. There is an insignificant change in the hands-together scores at T2/C after receiving video modeling for the right-hand performance. His MP score increases slightly by 3.36% at T2/D (total MP 52.94%, OP 48.57%) after receiving traditional instruction for hands together. In the third lesson, Charles’ hands-together MP reduces by 2.52% and OP reduces by 2.86% at T3/A (total MP 50.42%, OP 45.71%). However, his hands-together MP scores increase progressively for the remaining tests of week three, and throughout the two post-tests. His scores rise slightly by 4.2% in MP and 2.86% in OP at T3/B after receiving traditional instruction for hands together. His hands-together MP continuously grows by 3.36% at T3/C, where video modeling for hands together had been introduced prior to the test. His hands-together scores reach the highest of the third lesson at T3/D (total MP 61.34%, OP 51.43%) with the increase of 3.36% in MP and 2.86% in OP. In the fourth week, Charles hands-together scores increase by 4.21% in MP and 14.28% in OP at post-test I (total MP 65.55, OP 65.71%). A continuous progress is made at post-test II (total MP 69.75%, OP 68.57%) in the fifth week with the increase of 4.2% in MP and 2.86% in OP.

Figure 3.22 and 3.23 shows Nicholas’s progress of playing hands together. His hands-together baseline scores (T1/B) are 38.66% (MP) and 40% (OP). There is insignificant progress in the hands-together performance at T1/C (total MP 39.50%, OP 40%) after a short self-practice period. In the second lesson, Nicholas’s hands-together MP increases by 0.84% while his OP drops by 2.86% at T2/A (total MP 40.34%, OP 37.14%). Continuous positive progress is made at T2/B and T2/C, where two consecutive video modeling teaching segments for, respectively, the left hand and the right hand had been given prior to these two tests. His hands-together MP improves by 7.56% and OP by
8.57% at T2/B, and his hands-together MP improves by 4.2% and OP by 5.71% at T2/C (total MP 52.10%, OP 51.43%). Relative minor score changes in the hands-together performance are observed at T2/D after traditional instruction for the hands-together performance, as well as at T2/E (total MP 52.10%, OP 51.43%) after a short self-practice period. In the third lesson, an isolated improvement in the hands-together performance is observed at T3/A with the increase of 0.84% in MP and 2.86% in OP, followed by a sharp increase of hands-together MP by 10.92% and OP by 14.29% at T3/B, where traditional instruction for the hands-together performance had been utilized prior to the test. His hands-together MP continuously increases by 3.36% at T3/C, where video modeling for the hands-together performance had been given prior to the test. This positive progress in hands-together performance continues throughout the two post-tests. Nicholas’s hands-together MP increases by 2.52% and OP increases by 5.71% at post-test I (total MP 71.43%, OP 77.14%) in the fourth week. His scores are 5.88% higher in MP and 2.86% higher in OP at post-test II (total MP 77.13%, OP 80%) in the fifth week. His hands-together scores at post-test II reaches his highest among all his tests in the hands-together performances.

Figure 3.24 and 3.25 shows Sophia’s progress of playing hands together. Her hands-together baseline scores (T1/B) are 38.66% (MP) and 48.57% (OP). Her performance declines at T1/C (total MP 36.97%, OP 40%) with a large decrease in OP by 8.57%. In the first test of the second lesson at T2/A (total MP 49.58%, OP 62.86%), Sophia’s hands-together scores improve substantially with the increase of 12.61% in MP and 22.86% in OP. Her hands-together MP increase insignificantly while her OP drops largely by 8.57% at T2/B, where video modeling for the left-hand performance had been
given prior to the test. Her hands-together MP increases slightly by 1.68% and OP by 2.86% at T2/C, where video modeling for the right-hand performance had been introduced prior to the test. Her MP score reduces by 6.72% at T2/D, and improves by 5.04% at T2/E while her OP score continuously regresses by 5.71% at T2/E (total MP 50.42%, OP 51.43%). In the first test of the third lesson, Sophia’s hands-together performance improves greatly by 4.2% in MP and 11.43% in OP at T3/A (total MP 54.62%, OP 62.86%). However, there is a period of rapid decline of 5.88% in the hands-together MP and 11.43% in OP at T3/B after traditional instruction for the hands-together performance. To the contrary, her scores improve by 3.36% in MP and 5.71% in OP at T3/C, where video modeling for the hands-together performance had been introduced prior to the test. Minor progress is made at T3/D (total MP 54.62%, OP 60%) after a short self-practice period, although the OP score at T3/D is still slightly under the OP score at the first test of the lesson (T3/A). Sophia’s hands-together scores improve in both post-tests with a substantial increase at post-test II. Her scores at post-test I in the fourth week are 59.66% in MP and 60% in OP. Her scores increase by 5.04% in MP and 14.29% in OP at post-test II (total MP 64.71%, OP 74.29%), which presents her highest hands-together scores among her other tests.

**Hands-Together Score Changes after Video Modeling**

This section focuses on score changes of the hands-together performance after incorporating three video modeling teaching segments during the three weekly lessons, including P2/B and P2/C in week two, and P3/C in week three. The following analysis first explores the impacts of hands-together video modeling on hands-together
performance, and then evaluates how video modeling for individual-hand performances facilitates the hands-together performance.

*Hands-Together Score Changes after Hands-Together Video Modeling*

Table 3.8 shows the hands-together score changes after video modeling for the hands-together performance at P3/C. The results indicate a positive influence of video modeling for the hands-together performance on hands-together performance, although the improvement amounts are minimal.

<table>
<thead>
<tr>
<th>Teaching Segment</th>
<th>Student Name</th>
<th>H.T. Score Changes Between T3/B to T3/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3/C: Video Modeling for H.T</td>
<td>Amy</td>
<td>+2.52%</td>
</tr>
<tr>
<td></td>
<td>Charles</td>
<td>+3.36%</td>
</tr>
<tr>
<td></td>
<td>Nicholas</td>
<td>+3.36%</td>
</tr>
<tr>
<td></td>
<td>Sophia</td>
<td>+3.36%</td>
</tr>
</tbody>
</table>

Amy’s scores of the hands-together performance at T3/C are 67.23% (MP) and 80% (OP). Her hands-together MP increases by 2.52% and OP increases by 5.72% in comparison to the previous test T3/B. At the baseline performance of hands together (T1/B), she demonstrated the ability to play the left-hand *legato* against the right-hand *staccato*. The problems identified for the individual-hand performance were present in the hands-together performance. Specifically, her left hand lacked support of a rounded hand position, and her fingers were collapsed and slid backward after pressing down on the keys. Her right-hand position was slightly better, but her fingers were also collapsed. In the right-hand *staccato* motion, she tended to lower the wrist at the initiation of the touch, and she hesitated to move her fingers/hands to new positions. In terms of hand
coordination, she could not lift the left-hand wrist to breathe while she played *staccato* touch in the right hand. Amy showed some improvements in the second week of lessons. One of the major improvements was that she could lift up the left-hand wrist and release the fingers completely at the end of the slurs as she played the right-hand *staccato*. In the third week, her hands-together scores reduce by 3.37% in MP and 5.72% in OP at T3/A. Although she was able to play hands together at a faster tempo, her left-hand breathing motions were not as smooth as the prior week, and she hesitated to release the left-hand fingers at the end of the slurs. After traditional instruction for the hands-together performance (P3/B), her hands-together MP increases by 2.53% and OP increases by 5.72% at T3/B. The major score improvements occur in Tempo/Fluency in MP, which help increase the Artistry score in OP; however, her scores in Hand/Finger Positions and Hand Coordination decline slightly. Amy showed continuous progress at T3/C with the increase of 2.52% in MP and 8.57% in OP, where video modeling for the hands-together performance had been introduced prior to the test. Compared to T3/B, she improved greatly in the aspects of moving fingers to new positions accurately in advance and in being able to release the left-hand fingers at the breaths, although she could not lift up the wrist freely as she did in the second lesson. She improved her OP by showing better balance towards the left hand, and proper indication of crescendo and decrescendo in the last four measures of the piece. However, she performed less effectively at T3/D after a short self-practice period with the decline of 1.68% in MP and 11.43% in OP. She did not demonstrate a dynamic shape in the last four measures as effectively as she did at T3/C.

Charles’s scores for the hands-together performance at T3/C are 57.98% (MP) and 48.57% (OP). His hands-together MP increases by 3.36% while OP is maintained at
T3/C. At the baseline performance in the first lesson (T1/B), he showed the ability to play the left-hand *legato* against the right-hand *staccato* at a slow tempo (40bpm), but played in a halting manner and lacked ease in execution and coordination. It was also difficult for him to maintain a rounded and balanced position in the left hand as he played hands together. His left-hand breathing motions were inconsistent and without proper gestures. In the second lesson, Charles improved the hands-together performance greatly but still struggled with coordination. He showed slow progress in the remainder of the tests in the second lesson. In the third lesson, although he performed less effectively at T3/A, he showed more evident improvement throughout the remaining tests of the third lesson as the focus of the teaching shifted to hands-together performance. After receiving traditional instruction for the hands-together performance, his hands-together scores increase by 4.2% in MP and 2.86% in OP at T3/B. He was able to release the left-hand fingers at the breaths and improved his hand coordination in measure 8, although he still struggled with fluency and was not able to show smooth left-hand wrist motions in breathing. A continuous improvement in MP by 3.36% was shown at T3/C, where video modeling for the hands-together performance was utilized prior (P3/C) to the test. He played with less hesitation and was able to lift up the left-hand wrist at the end of a slur to breathe (on beat 4), although he failed to coordinate with the right-hand harmonic intervals on beat 4. Moreover, it was the first time he successfully connected the right-hand two-note slur in measure 8 with proper left-hand coordination. After a short practice period in his lesson, his performance at T3/D was maintained with a slight increase of scores.
Nicholas’s scores for the hands-together performance at T3/C are 67.23% (MP) and 68.57% (OP). His hands-together MP improves by 3.36% while his OP is maintained at T3/C. At the baseline performance (T1/B), he was able to play the left-hand *legato* against the right-hand *staccato* at a slow tempo (43bpm), but he played in a halting manner. His left hand was not able to breathe in between the phrases, and he missed several right-hand harmonic intervals on beat 4. In addition, he was not able to coordinate the hands properly in measure 8. In the second lesson, Nicholas made marked improvement in the hands-together performance at T2/B and T2/C, where video modeling for the individual-hand performance was given. The major improvement was shown in Hand/Finger Position and Hand Coordination. In the first test of the third lesson (T3/A), he maintained the performance level from the prior week with slight increase in MP and OP scores. After traditional instruction for the hands-together performance, Nicholas performed significantly better at T3/B with an increase of 10.92% in MP and 14.29% in OP. The improvements were displayed in all aspects of MP, including more advanced preparation for new hand/finger positions, more ease in coordination (releasing left-hand fingers at the breaths while playing right-hand harmonic intervals on beat 4), and more clear articulation in both hands. In terms of his OP, he improved greatly in Pitch/Rhythm Accuracy. His hands-together MP continuously improves by 3.36% at T3/C, where video modeling for the hands-together performance had been provided prior to the test. There was an immediate improvement in Hand/Finger Positions by showing a better hand posture and proper use of fingertips. Another noticeable change was that he demonstrated gentle down-up wrist motions for the right-hand two-note slur in measure 8; moreover, in contrast to the flat fingers 2 and 4 for the harmonic interval (C-E) in the
previous test, he played with curved fingers 2 and 4 at T3/C. Nicholas maintained his performance level and improved slightly at T3/D.

Sophia’s scores of the hands-together performance at T3/C are 52.10% (MP) and 57.14% (OP). Her hands-together MP improves by 3.36% and OP by 5.71% at T3/C. At the baseline performance (T1/B), she was able to play the left-hand legato against the right-hand staccato with proper balance towards the left-hand melody. She was aware of releasing the left-hand fingers at the breaths, although her wrist motions were not smooth. She played in a halting manner with bumpy wrist motions (especially in the left hand). Her right-hand staccato was not very solid and crisp due to less prompt actions. At the first test of the second lesson (T2/A), Sophia improved significantly by increasing 12.61% in MP and 22.86% in OP. The major improvement was shown in the aspects of Tempo/Fluency and Pitch/Rhythm Accuracy. However, Sophia had minimal progress in hands-together performance throughout the remaining tests of the second lesson. In the third lesson (T3/A), Sophia made relatively significant progress with the increase of 4.2% in MP and 11.43% in OP. However, her hands-together performance declined immediately at T3/B, where traditional instruction for the hands-together performance was introduced. The decline was shown in both hands’ articulation and pitch accuracy. Her hands-together performance slightly improved at T3/C after receiving video modeling for the hands-together performance. She was also able to play at a faster tempo with greater fluency, and more successfully coordinate and connect right-hand harmonic intervals in measure 8 after a few attempts. In terms of OP at T3/C, she improved Pitch/Rhythm Accuracy and Artistry. A continuous and small improvement was shown at T3/D after a short self-practice period.
Hands-Together Score Changes after Left-Hand Video Modeling

Teaching segment P2/B integrated video modeling for the left-hand performance, and teaching segment P2/C integrated video modeling for the right-hand performance. The focus of these two video teaching segments was not on hand coordination issues. However, working on the specific skills in an individual hand may benefit the hands-together performance. Table 3.9 shows the score changes of the hands-together performance after video modeling for the left hand was introduced. All participants but Sophia received positive results on the hands-together performance after receiving video modeling for the left-hand performance.

Table 3.9. Hands-together score changes after P2/B

<table>
<thead>
<tr>
<th>Teaching Segment</th>
<th>Student Name</th>
<th>H.T. Score Changes Between T2/A to T2/B</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2/B: Video</td>
<td>Amy</td>
<td>+4.20%</td>
</tr>
<tr>
<td>Modeling for L.H.</td>
<td>Charles</td>
<td>+1.68%</td>
</tr>
<tr>
<td></td>
<td>Nicholas</td>
<td>+7.56%</td>
</tr>
<tr>
<td></td>
<td>Sophia</td>
<td>+0.84%</td>
</tr>
</tbody>
</table>

The major improvement in Amy’s hands-together performance at T2/B was that she could gently lift up the left-hand wrist and release the fingers in the end of the slur as she played *staccato* touch in the right hand. Amy maintained this skill through the remainder of the tests in the second lesson. However, this ability was not retained in the other tests of the hands-together performances in this study, including the test after video modeling for the hands-together performance during the third lesson.
Charles also showed an intention to lift up his left-hand wrist at breaths (beat 4) at T2/B, but struggled with coordinating right-hand *staccato* touch at the same time. He also slightly improved in preparing new hand/finger positions and pitch accuracy.

Nicholas showed the largest improvement in the hands-together performance compared to the other three participants, after video modeling for the left-hand performance was given. The major improvement in MP was in the aspects of Hand/Finger Positions and Hand Coordination. After observing videos, his left hand was more securely placed in the correct position and he was able to curl his fingers. He was able to coordinate the opposite hand motions (left-hand *legato* against right-hand *staccato*) with more ease at T2/B, although he could not lift up the left-hand wrist to breathe at the end of the slur. He only demonstrated proper wrist breathing motions in the left-hand alone performance.

Sophia made minimal improvement in the hands-together MP by 0.84% while her performance in OP declined largely by 8.57%. Although the increase of MP is insignificant, the researcher observed a noticeable improvement in hand coordination: she could lift up the left-hand wrist and release the fingers at the breaths as she played *staccato* touch in the right hand. However, she did not successfully demonstrate this coordination through the remaining tests in the second lesson and third lesson. Luckily, this ability to coordinate opposite hand motions returned at post-test I and II. In addition, the major cause of decline of hands-together OP at T2/B was due to a lack of fluency and pitch/rhythm accuracy.

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6 Sophia’s feedback video for the third week of practice prior to post-test I specifically addressed the coordination of the opposite hand motions (left-hand breathing motion against right-hand *staccato*) through comparing expert-modeling and self-modeling in slow motion.
**Hands-Together Score Changes after Right-Hand Video Modeling**

Table 3.10 shows the score changes of the hands-together performance after video modeling for the right-hand performance was introduced. The results show that all participants except for Charles improved their hands-together performance after video modeling for the right-hand performance had been incorporated.

Table 3.10. Hands-together score changes after P2/C

<table>
<thead>
<tr>
<th>Teaching Segment</th>
<th>Student Name</th>
<th>H.T. Score Changes Between T2/B to T2/C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MP</td>
</tr>
<tr>
<td>P2/C: Video Modeling for R.H.</td>
<td>Amy</td>
<td>+5.05%</td>
</tr>
<tr>
<td></td>
<td>Charles</td>
<td>-0.84%</td>
</tr>
<tr>
<td></td>
<td>Nicholas</td>
<td>+4.20%</td>
</tr>
<tr>
<td></td>
<td>Sophia</td>
<td>+1.68%</td>
</tr>
</tbody>
</table>

Amy’s hands-together MP increases by 5.05% while there is no change in her OP score at T2/C, where video modeling for the right-hand performance had been integrated. When playing hands together, her right-hand movements to new positions were more direct and efficient, and she also improved hand coordination in measure 8. Nicholas’s hands-together scores improve by 4.2% in MP and 5.71% in OP at T2/C. He improved the coordination of opposite hand movements and articulation in both hands in MP, as well as rhythm accuracy and artistry in OP. Sophia’s hands-together scores improve slightly with the increase of 1.68% in MP and 2.86% in OP. She performed slightly better in the right-hand *staccato* touch with quicker actions. In the previous tests, her *staccato* actions were not quick enough to make crisp sounds and her fingers did not bounce into the air after striking the keys. There is no significant change for Charles’s hands-together scores at T2/C.
Effects of Video Materials on Home Practice

In addition to the three video modeling teaching segments during the second and third week of the lessons, video modeling with personalized feedback videos were provided to guide participants practicing at home after these two lessons (during the second and third weeks of practice). No video material was available after the first lesson (during the first week of practice) and after post-test I (during the fourth week of practice). In addition, all the participants received an assignment sheet that included practice guidelines and additional written feedback after each lesson (see appendix G).

In the second week of the practice, the researcher sent video materials either for the left-hand or the right-hand performance to the participants. Amy and Nicholas received the video materials for the right-hand performance, while Charles and Sophia received the video materials for the left-hand performance. In the third week of practice, all the participants received the video materials for the hands-together performance. In the fourth week of practice prior to the final test of the study (post-test I), no video material was available; therefore, the participants could only use the assignment sheet they received during the third lesson to guide practice.

Table 3.11 shows the score differences from the end of one lesson to the start of the next lesson. To be specific, this table presents score differences between the last test of the first lesson and the first test of the second lesson (from T1/C to T2/A), between the last test of the second lesson and the first test of the third lesson (from T2/E to T3/A), between the last test of the third lesson and post-test I (from T3/D to Post I), and between post-test I in the fourth week and post-test II in the fifth week (from Post I to Post II).
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice Week 1</td>
<td>Video Materials</td>
<td>MP</td>
<td>OP</td>
<td>MP</td>
<td>OP</td>
</tr>
<tr>
<td>Practice Week 2</td>
<td>Video Materials</td>
<td>MP</td>
<td>OP</td>
<td>MP</td>
<td>OP</td>
</tr>
<tr>
<td>Practice Week 3</td>
<td>Video Materials</td>
<td>MP</td>
<td>OP</td>
<td>MP</td>
<td>OP</td>
</tr>
<tr>
<td>Practice Week 4</td>
<td>Video Materials</td>
<td>MP</td>
<td>OP</td>
<td>MP</td>
<td>OP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test No.</th>
<th>L.H.</th>
<th>R.H.</th>
<th>H.T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1/C to T2/A</td>
<td>+2.59%</td>
<td>+3.89%</td>
<td>-3.36%</td>
</tr>
<tr>
<td>T2/E to T3/A</td>
<td>0%</td>
<td>+5.72%</td>
<td>0%</td>
</tr>
<tr>
<td>T3/D to Post I</td>
<td>+3.89%</td>
<td>+1.3%</td>
<td>-3.37%</td>
</tr>
<tr>
<td>Post I to Post II</td>
<td>+5.72%</td>
<td>0%</td>
<td>-5.72%</td>
</tr>
</tbody>
</table>

Table 3.11 Results of video materials for home practice
The score differences between T1/C and T2/A show that all four participants received a majority of positive and substantial progress in their MP and OP after the first week of practice. The significant improvements in scores (over 10% either in MP and OP or both) appear in Charles’s right-hand and hands-together performance at T2/A, Nicholas’s left-hand performance at T2/A, and Sophia’s left-hand and hands-together performances at T2/A. The increasing ranges in the first week of practice are significantly larger than other weeks of practice. The improvements mostly appear in the aspects of Tempo/Fluency and Hand/Finger Positions in MP, and Pitch/Rhythm Accuracy and Artistry in OP.

During the second week of practice, the participants received the video materials for one hand performance: Amy and Nicholas received the right-hand videos, and Charles and Sophia received the left-hand videos. The results in the second week of practice indicate that the video materials for one hand performance helped maintain or improve the MP scores in the same hand, while all the participants’ MP scores, except for Sophia’s, drop in a relatively large degree in the hand that was not exposed in the videos. For instance, Amy and Nicholas received the video materials for the right-hand performance during the second week of practice, and their right-hand MP increase insignificantly by 1.3% (Amy) and 0.6% (Nicholas), while their left-hand MP reduce by 3.89% (Amy) and 7.79% (Nicholas). Charles and Sophia received the video materials for the left-hand performance during the second week of practice. Charles’s left-hand MP is maintained while the right-hand MP reduces by 6.5% at T3/A. Both of Sophia’s left-hand and right-hand MP scores improve, respectively, by 7.8% and 6.49% at T3/A.
In general, the improvement and regression varies between the participants after the second week of practice. Amy’s scores at T3/A indicate a decline. She only showed minimal improvement in her right-hand (treatment hand) Hand/Finger Positions and Articulation in MP. Charles’s scores do not improve, while the majority of scores decline. To the contrary, the selected hand video materials for home practice seem to be more effective for Nicholas and Sophia. Nicholas received the video materials for the right-hand performance; his right-hand scores improve by 0.6% in MP and 14.29% in OP, while left-hand scores reduce by 7.79% in MP and 8.57% in OP. His hands-together performance slightly improved. Sophia showed relatively evident improvement in all right-hand, left-hand, and hands-together performances at T3/A after utilizing video materials for the left-hand performance during home practice, although the improvement amount tends to be more significant in the left hand (treatment hand).

During the third week of practice, all participants received video materials for the hands-together performance. The score differences between T3/D and post-test I show that all participants’ MP scores in the left-hand, right-hand, and hands-together performances improve at post-test I, except that Amy’s right-hand MP is maintained. The majority of score changes in OP, regardless of the right hand, the left hand or hands together, are positive. The overall improvement amount at post-test I, where video materials for the hands-together performance had been provided during the third week of practice, is more significant than T3/A, where video materials for one hand performance had been provided prior to the test.

After post-test I, video materials were no longer available for participants to use at home. All the participants could only use the assignment sheet from the third lesson to
guide practicing and no additional feedback was provided. As with post-test I, no further instruction was provided during post-test II, and the participants only came to the research room to record the test after warming up their fingers. The purpose of removing video materials during the fourth week of practice and not providing additional feedback after post-test I was to evaluate performance retention between the fourth and fifth week. The score differences between post-test I and post-test II demonstrate a mix of increase and decrease in their left-hand and right-hand performances, while all their hands-together MP and OP scores improve relatively significantly. Nicholas’s scores at post-test II show the most consistent and positive progress in all his right-hand, left-hand, and hands-together performances, although his left-hand OP slightly drops. In addition, the decrease amount at post-test II for individual-hand MP (Amy, Charles, and Sophia) is minimal, such as 1.3% or 2.6%. Most participants’ OP scores improve or at least maintain at the same level at post-test II, except for a relative large decline of 8.57% in Sophia’s right-hand performance and minimal decrease of 2.85% in Nicholas’s left-hand performance. The above results show that all four participants were able to retain and improve their hands-together performance without video materials during the fourth week of practice with general positive progress or minimal regression in their individual-hand scores.

Chapter 3 has presented the results of incorporating video modeling with video feedback for developing mid-to-late elementary piano students’ motor skills in learning the piece “Polka” by Kabalevsky. The effects of this method on other musical aspects of performance and the participants’ retention of skills have been also evaluated. The analysis of this chapter covered the following: pre-tests results; performance progress
over the five-week study; score changes in the left hand, the right hand, and hands
together after three video modeling teaching segments; and the effects of video materials
on home practice. Chapter 4 will summarize the results of the study and provide
recommendations for future studies.
CHAPTER 4

SUMMARY

Video modeling is a new pedagogical trend, during which learners watch a video recorded demonstration and utilize the information acquired from the video to imitate, modify, and improve targeted skills. Three major forms of video modeling have been widely integrated in the field of sports and physical education, including self-modeling, expert-modeling, and model’s superposition (analyzing motions between self-modeling and expert-modeling simultaneously). Self-modeling provides learners a realistic view of his or her performance, while expert-modeling illustrates a goal performance. Guided analysis through comparison of self-modeling and expert-modeling facilitates a deeper understanding of the differences between these two models and problem detection. Therefore, video modeling is not only used for presenting information of a certain skill, but also used for providing visual feedback for further refinement of the skill. Moreover, with the development of motion analysis software, learners can receive more effective video feedback by using various analytical tools and display modes (slow motion, split screen, drawing tools, etc.). Following the trend of effective use of video modeling in sports and physical education to facilitate motor learning, the researcher experimentally adapted this method into piano teaching. The present chapter summarizes the results of the study of using video modeling with video feedback for developing mid-
to-late elementary piano students’ motor skills in learning the piece “Polka” from Op. 39 by Kabalevsky. In addition, the benefits for other musical aspects of performance and performance retention have been evaluated.

The study used a multiple baseline design across behaviors. Five elementary piano students, 8 to 9 years old, enrolled in the Center for Piano Studies at the University of South Carolina were selected to participate in this study. The full-scale research took five weeks, including three weekly lessons in the first three weeks and post-test I during week four and post-test II during week five. At the time of the post-tests, no lesson was provided, and the participants only came to the research room to record their post-tests. The researcher taught a piece “Polka” from Op. 39 by Dmitry Kabalevsky. The piece features a *legato* melody in the left hand accompaniment with *staccato* harmonic intervals in the right hand on off-beats. The technique of executing different articulation in the right hand and the left hand was relatively new to all the participants. The targeted motor skills (behaviors) in this piece include left-hand *legato* touch, right-hand *staccato* touch, and hands-together coordination.

Beyond traditional instruction, video modeling was integrated into the teaching sequence. In the first lesson, all the participants learned “Polka” hands separately and hands together via traditional instruction. In the second lesson, two teaching segments (P2/B: left hand, P2/C: right hand) utilized video modeling for the individual hand performance, followed by a traditional teaching segment for the hands-together performance. In the third lesson, a traditional teaching segment for the hands-together performance was given first, and then video modeling (P3/C: hands together) was incorporated to further address the issues in the hands-together performance.
Video modeling in this study integrated expert-modeling, self-modeling, and the comparison of the two models. During the lessons, two display screens (one iPad and one iPhone) were connected to two GoPro cameras that captured two angles of hand movements (overhead and side views). The participants observed expert-modeling at the original speed and in slow motion via a main display screen (iPad), and then replicated the movements while they used two display screens as mirrors to monitor their performances captured by two GoPro cameras. After a few practice repetitions, a short segment of the participants’ performance was recorded for self-modeling. All the video modeling teaching segments incorporated video feedback—displaying, analyzing and comparing videos of self-modeling and expert-modeling—by using a motion analysis application downloaded to the iPad and iPhone. In addition, video materials were provided after the second and third lessons to guide practice at home. The video materials included videos of expert-modeling and personalized feedback videos of self-modeling in contrast to expert-modeling.

This chapter provides a summary of the performance results of four participants who demonstrated similar levels of technical and reading skills in the pre-test at the beginning of the first lesson and completed the test requirements throughout the study. The results of the study aims to answer the following research questions:

1. Is there a significant improvement in executing a targeted motor skill after the treatment (video modeling with video feedback) is introduced?

2. Is there a significant improvement in demonstrating other aspects of performance, including pitch/rhythm accuracy, dynamics, balance, and artistry, after the treatment is introduced?
3. Does the improvement show in all targeted motor skills or other aspects (those listed above) of performance after the treatment is introduced?

4. Is there a significant improvement when video modeling with video feedback is available during home practice?

5. Can students retain their motor performance and other aspects of performance one week after removing video modeling with video feedback from home practice?

Additional findings will be included in this chapter to answer the following questions:

6. Does showing a good model of one hand in video modeling positively affect the performance of the other hand?

7. Can the participants retain the improved skills of one hand as the technical focus of video modeling shifts to the other hand (during the second lesson)?

Effects of Video Modeling for Targeted Motor Skills

This section summarizes the effects of the three video modeling teaching segments during the second and third lessons for developing its targeted motor skills in the videos. There were two consecutive video modeling teaching segments for the hand-separate performance in the second lesson. Specifically, video modeling for the left-hand performance (P2/B) was targeted for the left-hand legato touch, and video modeling for the right-hand performance (P2/C) was targeted for the right-hand staccato touch. Another video modeling teaching segment for the hands-together performance (P3/C) was given in the third lesson after a traditional teaching segment, and both teaching
segments targeted the hand coordination issues. The first two subsections answer research question 1 (improvement in executing a targeted motor skill after the treatment is introduced), and the third subsection answers research question 3 (improvement in all targeted motor skills after the treatment is introduced).

*Video Modeling for Hands-Separate Performance*

The results show that video modeling for the hands-separate performance during the lessons significantly improved participants’ motor performance for the targeted skills in a single hand. After receiving video modeling for the left-hand performance at P2/B, all four participants showed marked improvement in their left-hand motor performances at the following test T2/B. Two participants (Amy and Charles) received their highest left-hand motor performance score at T2/B in comparison to their left-hand motor performance in their other tests. In the aspects of Hand/Finger Positions, they were able to demonstrate better hand posture, the use of fingertips in a more consistent manner, and more advanced preparation for new hand/finger positions. In Articulation, all four participants improved their breathing motions by showing gentler and smoother hand and wrist motions. However, one participant (Nicholas) showed increased tension in his hand and shoulder as he tried to match the expert’s movements. Therefore, in addition to understanding the movement patterns of a certain skill, students should be informed of how alignment works to prevent unnecessary tension.

After receiving video modeling for the right-hand performance at P2/C, three participants (Charles, Nicholas and Sophia) showed remarkable improvement in the right-hand motor performance at the following test T2/C. Two participants (Charles and Sophia) demonstrated their highest improvement in the right-hand motor performance.
among all their right-hand tests. The researcher noticed several positive changes in their right-hand motions. They showed a better control of hand movements in *staccato* touch; for instance, there were less bumpy wrist motions and more efficient *staccato* actions. They moved their fingers more directly and accurately to the new positions. In addition, they successfully connected the two-note slur in measure 8, and it was the first time that Charles and Nicholas demonstrated this skill. Although there is no score change in Amy’s right-hand performance at T2/C, she was able to demonstrate the skills addressed in the videos in her later test of the lesson. It is likely that her inability to immediately improve was due to insufficient rehearsal time; she was able to process this new ability by the end of the lesson.

Moreover, video modeling for the hand-separate performance is likely to help improve the hands-together motor performance, although the improvement amount was less significant than the targeted skills in a single hand. Therefore, targeting a segment (the left hand or the right hand) of the overall motor performance (hands together) may benefit the overall motor performance. After video modeling for the left-hand performance was introduced (P2/B), all participants largely improved their left-hand motor performance, and the positive progress also showed in their hands-together motor performance in varied degrees, regardless of the fact that three participants’ right-hand motor performance declined significantly. From the video observation, the participants were able to partially transfer their improved skills of playing left-hand alone to their hands-together performance. One of the significant improvements was the increasing ability to coordinate between the left-hand breathing motion and the right-hand *staccato* touch. Amy and Sophia coordinated nicely by gently lifting the left-hand wrist to breathe
as their right hands played *staccato* touch. However, they could only retain this skill temporarily: Amy failed to demonstrate this skill after the second lesson and Sophia was not able to retain this skill in the following test sessions.

A similar phenomenon was found at T2/C: followed by an immediate improvement in the right-hand motor performance after video modeling for the right hand, three participants slightly improved their hands-together motor performance, although their left-hand motor performance dropped largely. It was notable that even though there is no score change in Amy’s right-hand motor performance and her left-hand motor performance largely declines at T2/C, she still managed to improve her hands-together performance. The improvement in the hands-together performance resulted from her right-hand movements, for example, being able to move fingers to new positions more directly. Amy’s performance shows that newly acquired information may not be demonstrated immediately after the treatment, but may be assimilated later.

*Video Modeling for Hands-Together Performance*

During the third lesson, video modeling for the hands-together performance (P3/C) was incorporated after the traditional teaching segment for the hands-together performance (P3/B). Based on the teaching plan, the researcher addressed the hand coordination issues with a traditional method first, which mainly included the opposing motions in the left-hand *legato* and the right-hand *staccato*, the left-hand gentle breathing motion against the right-hand quick up motion in *staccato*, and the coordination of the right-hand two-note slur with the left-hand *tenuto* touch in measure 8. These issues continued to be addressed in the following video modeling teaching segment with priority given to the issues that could not be resolved under traditional instruction.
The results show that video modeling for the hands-together performance continuously refined the hands-together motor performance after a traditional method that addressed the similar issues; the improvement amounts are small in range. After traditional instruction for the hands-together performance at P3/B, three participants’ hands-together motor performance improved while one’s performance declined at T3/B. After video modeling for the hands-together performance was utilized, all participants improved slightly in their hands-together motor performance at T3/C. The positive progress was shown in varied aspects of their motor performance. Compared to their performance at the previous test T2/B, Amy improved greatly by moving fingers to new positions in advance and being able to release left-hand fingers completely at the end of the slur; Charles was able, for the first time, to coordinate the right-hand two-note slur with the left hand properly in measure 8; Nicholas demonstrated better coordination and finger movement in measure 8 by showing accurate down-up wrist motion for the two-note slur and playing with curved fingers 2 and finger 4 for the last harmonic interval in the right hand; Sophia, after several attempts, also improved her coordination between the right-hand two-note slur and the left-hand tenuto touch in measure 8.

The most challenging skill of playing hands together was to coordinate the left-hand gentle breathing motion at the end of each phrase with the right-hand quick up-motion for the staccato. After receiving video modeling for the hands-together performance, none of the participants demonstrated this coordination skill with ease although two participants performed slightly better at the release in the left hand. It was probably due to the nature of the complexities of this skill. The participants could not assimilate all the information with limited instruction time, and thereby incorporate it in
accurate actions. It is worth mentioning that two participants (Amy and Sophia) demonstrated this skill temporarily in the previous lesson (the second lesson) after video modeling for the left-hand performance had been incorporated. Therefore, in addressing a coordination skill that involves more complex movement patterns, guiding learners to thoroughly address a single movement (one-hand movement) before putting all the movements together (hands-together movements) seems to be more effective.

In addition, video modeling for the hands-together performance had positive influence on the hands-separate motor performance; yet, the improvement amounts were less significant and consistent across the participants in comparison to the single-hand improvement after targeted video modeling. After video modeling for the hands-together performance was introduced (P3/C), three participants showed minimal improvement in their individual-hand motor performance, and one participant (Nicholas) effectively improved all aspects of the individual-hand motor performance.

Summary: Video Modeling for Targeted Motor Skills

From the above analysis, video modeling during the lessons improved all targeted motor skills; the improvement amount varied across the participants. Video modeling during the lessons proved more effective for the targeted motor skills in one hand than both hands together. The less significant improvement for the hands-together motor performance is likely due to two reasons. First, similar objectives had already been addressed in the previous teaching segment. Secondly, young participants may not be able to perceive all the information at once under limited instruction time due to the complexities of the hands-together performance. In addition, video modeling for the hands-separate performance not only significantly improved the targeted motor skills in
each hand, but also, to some extent, showed positive impacts on the coordination of the hands-together motor performance. Similarly, there was an inconsistent improvement in their individual-hand motor performance after receiving video modeling for the hands-together performance.

Effects of Video Modeling for Other Aspects of Performance

The ultimate goal of learning a piece is to develop students’ ability to play with expressivity and artistry. Although the primary purpose of the study was to focus on how to refine the movements by incorporating video modeling, the researcher sought to answer if the improvement in motor learning could eventually benefit other aspects of musical performance. Three evaluative items were included in other aspects of performance in this study: Pitch/Rhythm Accuracy, Dynamics (Balance/Dynamics for the hands-together performance only), and Artistry. This section answers research question 2 (improvement in other aspects of performance), and the last paragraph answers research question 3 (improvement in all other aspects of performance).

The results show that the benefits of video modeling seen in targeted motor skills are also positively reflected in their overall scores in other aspects of performance. The data graphs (see figure 3.2 through 3.25) in chapter 3, which depict each participants’ progress in motor performance (MP) and other aspects of performance (OP), also indicate a relative parallelism in the increase and decline throughout the study, with few exceptions.

Similar to what had been found in the single-hand motor performance after receiving targeted video modeling, the majority of the participants significantly improved
other aspects of performance for the hand targeted in the videos; this was accompanied by a decline in other aspects for the hand that was not displayed in the videos and a minimal improvement in other aspects for the hands-together performance. With the significant improvement in the left-hand performance after receiving left-hand video modeling, all participants received a better score in Artistry while the results in Pitch/Rhythm Accuracy and Dynamics varied across the participants. Charles improved all aspects of his other aspects of performance immediately, while Nicholas improved Artistry in exchange with a slightly lower grade in Pitch/Rhythm Accuracy. After receiving video modeling for the right-hand performance, three participants significantly improved their motor performance and other aspects of performance while one participant had no score change in both scores. These three participants showed varied improvement across the other aspects of performance. For example, Charles improved in Dynamics and Artistry as a result of lighter touch in staccato, and Nicholas and Sophia improved the Pitch/Rhythm Accuracy while demonstrating more efficient movements to new hand positions.

After video modeling for the hands-together performance, there was positive or no progress in the other aspects of their individual-hand and hands-together performance. With slight improvement in the hands-together motor performance among all the participants, two participants improved and two participants maintained their other aspects of hands-together performance. Amy improved in her Balance/Dynamics and Sophia improved in her Pitch/Rhythm Accuracy and Artistry.

Based on the above analysis, the use of video modeling had a general positive influence on other aspects of performance for the hand(s) displayed in the videos, but the
improvements in Pitch/Rhythm Accuracy, Dynamics, Balance, and Artistry of other aspects of performance appeared to be inconsistent across the participants. Therefore, the researcher recommends teachers explore a comprehensive approach to address diverse musical issues. Video modeling can be an effective a tool to help young pianists refine their movements and improve other aspects of musical performance, but it must be used with care. Over-emphasizing the replication of movements via observing videos leads to overlooking other valuable aspects of musical learning, such as listening, imagination, and encouraging individual freedom of movement. Therefore, incorporating other approaches—such as developing the sensibility to sound, encouraging the creative interpretation of musical elements, discovering the connection between movements and sound—is also important to help young pianists reach their ultimate performance goals.

**Effects of Video Materials for Home Practice**

This section answers research question 4 (improvement when video modeling with video feedback is available during home practice), and research question 5 (performance retention one week after removing video modeling with video feedback).

The study consisted of four weeks of practice. After each lesson, the researcher provided a practice assignment with guidance and written feedback. In addition to the assignment sheet, the researcher provided video materials during the second and third week of practice. The video materials included expert-modeling and self-modeling with feedback videos. During the second week of practice, two participants (Amy and Nicholas) received the video materials for the right-hand performance only, while the other two participants (Charles and Sophia) received the video materials for the left-hand
performance only. During the third week of practice, all participants received the video materials for the hands-together performance; in the meantime, the researcher removed the video materials from the previous week. During the fourth week of practice, no video material was available, and therefore, the participants could only use the same assignment sheet from the third week to guide practice. The following section presents three conclusions of the video materials for home practice.

First, the video materials for the selected hand performance during home practice helped the participants maintain or improve their motor performances minimally on the same hand, and the improvement and regression of other aspects of performance varied across participants; in the meantime, the majority of the participants’ performances (in both motor and other aspects) on the hand that was not included in the video declined significantly. The exception was observed in Sophia’s performance. She showed evident improvement in all her right-hand, left-hand, and hands-together performances even though the video treatment was only targeted for the left hand during home practice.

Second, the video materials for the hands-together performance during the third week of practice positively influenced the majority of the hands-separate and hands-together performances, both in motor and other aspects; and was more effective than the video materials for one hand performance in the second week of practice. Perhaps the hands-together performance provided a clearer goal for a complete performance than one hand performance; therefore, the participants used the hands-together videos more efficiently at home. Moreover, video modeling of hands-together performance include more complex information than the single-hand performance. Perhaps observing videos
at home allow sufficient time for the participants to digest the complex information of the hands-together performance.

Third, without any further assistance of the video materials during the fourth week of practice, all the participants significantly improved their hands-together performance (motor and other aspects) at the final test of the study—post-test II. There were also inconsistent results—increase and decrease—in their individual-hand performance, although the regression was minimal. This indicates that all the participants were able to retain and continue refining the newly acquired skills on their own one week after removing video materials from home practice. The continuous improvement during the last two weeks of the study demonstrates the effective use of incorporating video modeling with video feedback into piano teaching. The participants’ improvement, however, might be attributed to the fact that they practiced more diligently than previous weeks as they were informed that the last two weeks were the post-tests.

Additional Findings: Effects Upon Un-targeted Skills

The initial research questions did not consider the impacts of video modeling upon the individual hand that was not exposed during the teaching segment in the second lesson. After video modeling for a single-hand performance was introduced during the second lesson, the researcher observed a significant improvement on the same hand, accompanied by a significant regression on the unexposed hand. Therefore, additional findings of this study discuss how technical focus on one hand in video modeling influences the security and ease of the other hand’s performance. The following two paragraphs answer research question 6 and 7 respectively.
While the content of video modeling for the left-hand performance \((\text{legato})\) or the right-hand performance \((\text{staccato})\) seems irrelevant to each other, did showing a good model of one hand positively affect the performance of the other hand? The results show that the majority of the performances with the unexposed hand significantly declined. After receiving video modeling for the left-hand performance \((P2/B)\), positive impacts were evident in their left-hand performance, while the majority of the right-hand performance declined. Similarly, after video modeling for the right-hand performance \((P2/C)\), marked improvement was shown in the majority of the right-hand performance, while the majority of the left-hand performance declined. Although the piece required different articulation and techniques for the individual hand, rounded hand position and the proper use of fingertips were the common issues the researcher constantly emphasized during all teaching segments. Video modeling for the left-hand performance improved the left-hand posture, but did not influence their right-hand posture in a positive way, and vice versa.

Moreover, while the use of video modeling for the left hand resulted in an immediate improvement in performance, the skills were less likely to be retained as the technical focus of video modeling shifted to the right-hand performance. Instead, the majority of the left-hand performance declined significantly while their right-hand performance improved substantially. In the aspects of motor performance, Hand/Finger Positions and Articulation were the major cause of the decline in the left hand. Furthermore, without additional video reinforcement for the left-hand performance at \(P2/C\), the previously improved skills became less accurate. For example, Amy improved breathing motions by showing gentle wrist motions at \(T2/B\), but she developed a larger
movement by lifting the left hand higher from the keyboard at T2/C. Sophia slightly improved her bumpy wrist motion at T2/B, but she started to position her wrist high during her playing at T2/C. Charles went back to the old habit of breathing abruptly at T2/C. An exception was observed in Nicholas’s performance, whose left-hand performance showed continuous progress at T2/C. This suggests that participants have different abilities to retain and use the information acquired from the previous videos. For the participants who were unable to retain the skill, additional reinforcement is needed to solidify the information they acquired before.

**Reflections on Video Modeling in Teaching**

Bandura’s (1977, 1986) four sub-processes of observational learning explained the process of gaining skills from observation. These four sub-processes include attentional process, retention process, production process, and motivation process. Video modeling can be an effective medium to facilitate information perception, retention, and to guide appropriate actions. The result of the study showed the great advantages and some challenges of incorporating this new method for developing mid-to-late elementary piano students’ motor learning and other aspects of performance.

The researcher concludes that there are several benefits to integrating video technology during the piano lessons. First, observing a model’s performance via videos restricts the field of focus; therefore, the objectives can be more accurately perceived at the initial process of information selection (attention process). During live demonstration, the participants’ attention might not always be on the target (the researcher’s hands) as expected. The participants might switch their attention between the researcher’s hands,
the score, and/or other unrelated places. To the contrary, in the video modeling teaching segments, all the participants showed a certain level of interest in the video technology and were able to concentrate on watching the videos during the majority of the required time. Even when a participant’s attention shifted away from the videos, the researcher refocused his or her attention by using the technology. For example, the researcher froze the video when the participants lost focus and asked them to watch the video again; the researcher showed students some engaging tools, such as changing the speed of the videos or using drawing tools to highlight certain movements, and encouraged them to interact with the video technology.

Second, video modeling allows viewing a demonstration as many times as needed with multiple angles; therefore, the complex movement patterns could be fully perceived. In this study, the researcher easily switched between two different angles of view in the videos, and moved the videos forward and backwards for multiple viewings. During the study, the researcher found out that it was beneficial for the participants to observe the fingertips and finger movements via an overhead view captured by the GoPro camera, while the side view of the hand captured by the other camera facilitated the observation of larger hand or arm movements, such as breathing motions. Without video assistance, the participants were likely to observe one angle of a demonstration during live observation because their fields of views were restricted by where they sat or stood (either the left side or the right side of the researcher).

Third, synchronous playback of self-performance in multiple video angles allows learners to fully observe their performances, to detect errors immediately, and to adjust the movements promptly to match the expert’s model. In this study, while the participants
rehearsed a movement, they used two display screens as mirrors to monitor their movements captured by two GoPro cameras in two different angles (overhead and side views). The display screens were placed at the music rack. Therefore, they had an opportunity to thoroughly and promptly evaluate their performance at two different angles as they were playing. Without this video assistance, the participants could only see their hand movements from above, and their self-evaluation might be less accurate due to incomplete observation.

Fourth, providing learners a platform to compare expert-modeling and self-modeling in a split screen facilitates critical thinking and continuous refinement of a skill. During the video modeling teaching segment, the researcher recorded a small portion of the participant’s performance, and played back instantly via a motion analysis application. The researcher used various tools in this application to guide them to discover the differences between expert-modeling and self-modeling. Then they could identify their problems and improve their skills with a deeper understanding of the movement patterns.

Although there are many advantages of using video modeling in the lessons, it requires longer instructional periods than traditional instruction in order to fully address the contents in the lesson plan. During the study, the researcher felt there was not enough time to switch between different features of the video technology and provide a thorough analysis of the information presented in the videos. For example, the researcher had to take time to import the participants’ self-modeling into the iPad for motion analysis. Under the limited instructional time, the participants could only briefly watch a portion of their performance and the researcher had to give a brief comment without thoroughly evaluating the videos. Therefore, more effective results may occur if longer video
modeling instructional time is provided, so that learners can fully engage with the contents of the videos.

Additionally, how to transfer the complex visual information from video modeling to meaningful symbols are keys for learners to acquire and secure a targeted skill. In this study, the additional findings of this study showed the participants were less likely to retain a new acquired skill from a video modeling session during the lesson without further reinforcement. At the initial attentional stage, observing a movement via videos in multiple angles and slow motion helps learners to fully perceive the movement patterns. In the retention process, the selected information must be coded into symbolic forms and stored in memory for further actions. The coding process requires learners to understand each component of a skill and transfer them into meaningful symbols (such as language-based or visual-based labels). Bandura and Jeffery’s (1973) study reviewed in Chapter 2 showed that the observers who coded the modeling stimuli in symbolic form and rehearsed the memory code achieved the highest level of performance; however, the observers who failed to code the molding stimuli in symbolic form—even with many opportunities to practice—quickly lost the information they have learned.

During the video modeling teaching segments, the participants were asked to imitate a certain movement after a few viewings of the videos. Perhaps due to the lack of a meaningful explanation of complex movement patterns, the majority of the participants quickly lost their improved motor skill. Nicholas made an exception by continuously improving his left-hand motor skill at T2/C even though video modeling shifted to the right-hand performance prior to the test. In comparison to other participants, Nicholas showed the highest excitement with the video technology, and he responded more
actively than others during video observation. Perhaps this high engagement with video technology facilitated the information retention in his memory. It is also possible that his teacher has worked on similar techniques before participating in this study; therefore, he was able to easily recall the information after few viewings of the videos.

**Reflections on Video Materials for Home Practice**

Puopolo (1971) indicated that instrumental students only have a small portion (10%) of entire instrumental study time with their teachers, while spending the majority (90%) of time working on their own. For private piano lessons, students usually attend a 30-minute to 60-minute lesson per week; therefore, there are limited opportunities for them to observe a teacher’s demonstrations and receive feedback from their teachers. Without the teacher’s help during home practice, students may develop new problems and undesirable habits. Therefore, the researcher provided expert-modeling and produced feedback video for students to use at home.

Although the result showed general positive effects of using video materials for home practice, many factors may affect the accuracy of the results. In this study, parents were asked to track and report their children’s practice time and the use of videos in the assignment sheet, however, almost half of the reports were incomplete. According to the informal conversation with the participants at the beginning of the third lesson and post-test I, most participants were able to watch the videos one to two times during the practice week, but one participant verbally expressed that he had no time to watch the videos during the third week of practice. Therefore, the positive results of the video materials for home practice in this study were less convincing. It was possible that their
progress simply followed their normal learning curve rather than being affected by the video materials. Furthermore, the conditions of video observation at home may vary between the families, and the quality of the observation is difficult to control. The researcher did not collect information about the devices they used to watch the videos at home and how they used the videos during practice. A more defined and controlled environment is needed to evaluate the effectiveness of video materials for home practice.

**Reflections on the Use of Technology**

Although the study showed positive impacts of using video modeling in developing mid-to-late elementary piano students’ motor skills and other aspects of performance, the researcher discovered several challenges to be addressed prior to future application.

First, technology malfunctions may disrupt the teaching flow. During this study, the researcher experienced device pairing issues and lost wireless connections before and during the lessons. When the technology problem appeared, the researcher had to delay the progress of the lesson as planned to fix the technology issues. Dealing with this under limited preparation or instruction time brought additional stress to the researcher, which distracted her from focusing on the teaching content and the participant’s performance.

Second, the frequent use of technology may cause distractions for both participants and the researcher during the lessons. Due to the design of the study, the researcher had to constantly monitor the status of the GoPro cameras from two display devices to ensure all the tests were successfully recorded. This distracted the researcher from focusing on observing and listening to the participants’ performances. Moreover,
during the video teaching segments, the researcher was busy switching among the
different features of the technology. For example, the researcher needed to play different
videos via a motion analysis application, set up the devices that allowed the participant to
monitor their movements simultaneously on two display screens, to record participants’
performances and playback instantly through a motion analysis application, etc. The
intensive uses of multiple features of the technology distracted the researcher from
personal engagement with the participants and perhaps distracted the researcher from
providing effective instruction. Moreover, the participants had to wait patiently during
the time the researcher switched among different devices or set up different features of
the technology. During the waiting time, they started to play around with the cameras,
look around, or randomly play the piano. Therefore, the researcher had to draw their
attention back when the technology was ready to use.

Third, the researcher spent a significant amount of time after the lessons to
produce feedback videos for each participant. The researcher used the application
Slowmo on the iPad to create the videos and uploaded these to a computer for final
editing. With one of the important features in Slowmo, the researcher played the pre-
existing videos in a regular speed and in slow motion and recorded verbal feedback along
with it. The researcher also added text and highlight markings on the videos, and
analyzed two videos in a split screen. However, to make a small segment of the video
(less than one minute) by including all the above features, it took twenty to thirty minutes
to render the video through the application. Sometimes, the application shut down
unexpectedly and the researcher had to re-start the process. The old models of the iPad
(2013 edition) used in this study may affect the speed of rendering videos. The extensive
amount of time used for making feedback videos for students is not practical in real teaching situations. Further investigation about how to improve the efficiency of providing feedback videos to students for home practice is encouraged.

**Recommendations for Future Studies**

In this study, the researcher discovered various possibilities to engage with the portable video technology during the lessons, and incorporated it into a traditional instructional sequence of teaching a piece. Based on the results of the study, the researcher suggests the following possibilities for future studies.

1. Future research can compare the effectiveness of different modes of instruction for piano lessons. For example, compare the use of traditional instruction, video modeling instruction, and/or a combined approach (traditional and video modeling instruction). Moreover, the comparison of different forms of video modeling in piano teaching is also recommend to investigate, including expert-modeling, self-modeling, and model’s superposition. Researchers can also incorporate additional aids into video modeling and evaluate its effect, such as verbal feedback, written feedback, or the feedback from motion analysis software.

2. The researcher recommends a similar study that focuses on one or few technical issues with video modeling rather than focusing on many technical issues at a time. The design of the study attempted to address all the technical issues of the piece “Polka” by Kabalevsky, including the left-hand *legato* touch and breathing motions, the right-hand *staccato* touch, two-note slur in measure
8, and hands-together coordination issues. However, working on one specific problem by presenting videos of expert-modeling and self-modeling, and comparing the two models, took much longer than traditional instruction. The researcher felt less able to address multiple issues under the limited instructional time with the use of video technology.

3. To facilitate a long-term gain of a skill for elementary piano learners, future research about duration and frequency in using video modeling during the lessons is recommended. In addition, it is encouraged to investigate whether presenting complex movement patterns with meaningful symbols (such as language-based or visual-based labels) during video modeling can facilitate a deeper understanding of movements, skill acquisition, and performance retention.

4. This study was limited to five mid-to-late elementary piano students over a five-week span in a private setting. Future research can target different levels or ages of piano students in a private or group class setting with larger sample sizes and for a longer duration.

5. Technology malfunctions and the intensive use of technology caused distractions for both participants and researchers during this study, which might negatively affect the outcome of the study. Improving the design of the technology to minimize interruption in teaching flow is highly recommended for similar research.

6. This study did not include participants’ and parents opinions about using video modeling in the piano lessons and during home practice. Future research is
encouraged to investigate how students and parents feel about the use of video modeling during piano studies. Additionally, researchers can investigate teachers’ opinions and attitudes about the use of video modeling technology in private or group class settings.

7. The researcher recommends investigating a more applicable method to create feedback videos for students to use at home. Making personalized feedback video with motion analysis was time consuming in this study. Further investigation in technology is encouraged to facilitate the ease of making feedback videos.

8. The condition and qualities of using video materials at home were difficult to control in this study. To investigate the effectiveness of video materials for home practice, future studies need to develop more reliable tracking system of students’ home practice and provide more detailed instruction to both students and parents about how to use videos at home.

Conclusion

With the effective use of video modeling in the fields of sports and physical education to develop motor skills, the researcher tired to discover new possibilities for piano teachers in helping young piano learners overcome technical challenges and generate desired performance outcomes. Video modeling is a new pedagogical trend, during which learners watch a recorded demonstration and utilize the information acquired from the video to imitate, modify, and improve targeted skills. The new technology, such as instant playback, slow motion, motion analysis tools, allows learners
to receive accurate information of a skill and prompt feedback of their performances in comparison to model’s performance.

This was an exploratory study to incorporate video modeling into private piano lessons. The primary purpose of the study was to investigate the effectiveness of video modeling with video feedback in developing mid-to-late elementary piano students’ motor skills in learning a given piece. The researcher also evaluated the benefits of this method for other aspects of performance, including pitch/rhythm accuracy, dynamics, balance, and artistry, as well as performance retention. Video modeling in this study integrated expert-modeling, self-modeling, and the comparison of the two models. Motion analysis software was used to provide video feedback—displaying, analyzing and comparing videos of expert-modeling and self-modeling.

The results of the study show that incorporating video modeling during the private piano lessons effectively improved all targeted motor skills in various levels across the participants. Video modeling during the lessons proved to be more effective for the targeted motor skills in one hand rather than both hands together. There was an immediate and significant improvement in the targeted skills in one hand after video modeling. The less significant improvement for hands-together motor performance is likely due to two reasons. First, similar objectives had already been addressed in the previous teaching segment. Secondly, young participants could not perceive all the information at once under limited instruction time due to the complex nature of hands-together performance.

Moreover, video modeling for the hands-separate performance during the lessons not only significantly improved the targeted motor skills in each hand, but also, to some
extent, showed a positive impact on the coordination of the hands-together motor performance. Therefore, targeting a segment (left hand or right hand) may benefit the overall motor performance in hands together. In addition, video modeling for the hands-together performance had a positive influence on the hands-separate motor performance; yet, the improvement amounts were less significant and consistent across the participants in comparison to the single-hand improvement after targeted video modeling.

The benefits of video modeling seen in targeted motor skills are also positively reflected in their overall scores in other aspects of performance, however, the improvements in Pitch/Rhythm Accuracy, Balance, Dynamics, and Artistry of other aspects of performance showed to be inconsistent across participants. Video modeling in this study mainly focused on improving the efficiency of hand movements. In a real teaching situation, a comprehensive approach, such as developing sensitivity to the sound and encouraging creative interpretation and expressivity, is recommended to address diverse musical issues.

The video materials (expert-modeling and feedback videos of self-modeling) for home practice showed general positive impacts on the targeted performance after one week of practice. The video materials for selected one-hand performance in the second week of practice helped the participants maintain or improve their motor performances minimally on the hand that received the treatment, and the improvement and regression of other aspects of performance varied across the participants; in the meantime, the majority of the participants’ performances (in both motor and other aspects) on the hand that was not included in the video declined significantly. The video materials for the hands-together performance provided in the third week of practice significantly improved
the majority of hands-separate and hands-together performances, both in motor and other aspects. However, the inconsistent reports from the parents about the use of the videos at home may affect the validity of the results.

Finally, the results of post-test II in the fifth week showed that all the participants were able to retain and continue refining the hands-together performance one week after removing the video materials from home practice. There was general positive progress or minimal regress in their individual-hand performance at post-test II.

In all, incorporating video modeling with video feedback into private piano studies show general positive results in helping elementary piano learners acquire and retain the targeted skills of playing the piece “Polka” by Kabalevsky. The improvement of the motor skills also benefited their overall other aspects of performance. While the positive progress of four participants in mid-to-late elementary level after receiving the video modeling treatment may not represent the whole group of piano learners, this research opens promising territory for piano educators in seeking better solutions to help piano learners improve motor skills and movement efficiency. The quality of the observation is directly related to the accuracy of evaluation and performance outcome. The use of video technology can provide additional eyes for both teachers and learners, capturing information that is easily overlooked during live observation. A fuller observation of a performance facilitates a comprehensive evaluation, thereby learners gain a deeper understanding to refine their performance and eventually generate desirable learning outcomes. In the meantime, video technology during piano studies should be used with care. When overusing video technology, piano students may not have an opportunity to benefit from other valuable approaches, such as cultivating the sensibility
to musical sound and developing imagination. Overall, to help pianists reach their ultimate musical goals, the researcher encourages integrating video modeling flexibly and creatively into piano lessons based on individual learning needs.
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Huiyun Liang  
School of Music  
813 Assembly Street  
Columbia, SC 29208  

Re: Pro00075587  

Dear Mr. Liang:  

This is to certify that the research study The Effectiveness of Video Modeling with Video Feedback on a Given Piece for Mid-to-Late Elementary Piano Students was reviewed in accordance with 45 CFR 46.101(b)(1), the study received an exemption from Human Research Subject Regulations on 3/26/2018. No further action or Institutional Review Board (IRB) oversight is required, as long as the study remains the same. However, the Principal Investigator must inform the Office of Research Compliance of any changes in procedures involving human subjects. Changes to the current research study could result in a recategorization of the study and further review by the IRB. Because this study was determined to be exempt from further IRB oversight, consent document(s), if applicable, are not stamped with an expiration date.

All research related records are to be retained for at least three (3) years after termination of the study. The Office of Research Compliance is an administrative office that supports the University of South Carolina Institutional Review Board (USC IRB). If you have questions, contact Arlene McWhorter at arlenem@sc.edu or (803) 777-7095.

Sincerely,  

Lisa M. Johnson  
ORC Assistant Director  
and IRB Manager
March 23, 2018

Ms. Huiyun Liang,

You have my support and approval to utilize six or fewer students from the Center for Piano Studies for your study, “The Effectiveness of Video Modeling with Video Feedback on a Given Piece for Mid-to-Late Elementary Piano Students.”

Please follow the guidelines below:

1. The Center database contains student’s ages, although student ages may not be exact. You may schedule an appointment with Katie Chandler, Admissions Assistant, to gather potential student participant names and teacher names. Contact information of students and parents will not be provided.

2. Discuss your study briefly with each student’s teacher, per your invitation letter. If a teacher is concerned about a student’s suitability for the study (for reasons such as behavior or progress in studies), defer to the teacher’s judgment and find an alternate student.

3. Utilize our Center for Piano Studies room schedule to make sure that your study will not cause conflicts with other scheduled lessons. Make certain your study time is officially scheduled either on TeamUp or 25Live.

4. Inform me when you will formally begin research procedures in lessons.

5. Inform me when you have concluded all research procedures in lessons.

Let me know if there is further information needed from me at any point during your research. I am happy to be of assistance.

Sincerely,

Sara Ernst
Assistant Professor of Piano and Piano Pedagogy
Director of the Center for Piano Studies, School of Music
sernst@mozart.sc.edu
803-777-1688
LIANG, HUIYUN
Fri 4/6, 10:27 AM

Flag for follow up: Start by Friday, April 06, 2018. Due by Friday, April 06, 2018.

Letter of Invitation_Lian...
92 KB

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Dear [Teacher's Name],

I would like to invite [Student's Name] for my dissertation project entitled “The Effectiveness of Video Modeling with Video Feedback on a Given Piece for Mid-To-Late Elementary Piano Students”. The attachment is the Letter of Invitation that I will present to the parent.

In this study, I will teach your student a given piece with the assistance of video technology. The total engagement of this study is Five Weeks. I will give your student three lessons (35-min to 40-min each) during the first three weeks. Your student will take two post-tests on the fourth and fifth week and each post-test will take no more than 5 minutes. The lesson can be scheduled either before or after your student’s piano lessons or theory classes at the USC School of Music.

If you feel comfortable to let your student participant in my study, would you be willing to introduce me to your student’s parent before or after your next scheduled lesson? I will explain the procedure of the study and present the Letter of Invitation to the parent at the same time.

If you agree for [Student’s Name] to participate in my study, please let me know when will be your next piano lesson with her. I would like to be there to meet the parent. Thank you very much for your help.

Sincerely,

Huiyun
APPENDIX D

LETTER OF INVITATION

University of South Carolina
School of Music

Study Title: The Effectiveness of Video Modeling with Video Feedback on a Given Piece for Mid-To-Late Elementary Piano Students

Huiyun Liang, principal researcher

Dear Parent/Guardian,

Your child is invited to participate in a research study conducted by Huiyun Liang, a doctoral candidate in the School of Music at the University of South Carolina. The results of the study will be presented in a dissertation in partial fulfillment of the requirements for the Doctor of Musical Arts in Piano Pedagogy. The purpose of this study is to investigate the effectiveness of incorporating video modeling with video feedback on teaching a given piece for developing mid-to-late elementary piano students’ motor skills. This form explains what your child will be asked to do during this research study. Please read it carefully and feel free to ask the researcher any questions before you make a decision to participating.

Description of the Study
The total engagement of this study is five weeks. Over the course of the first three weeks, your child will receive three 35-min to 40-min lessons from the researcher. The researcher will work on a specific piece with your child that will focus on the development of motor skills, which include hand positions, hand/finger movements, articulation, and hand coordination. Video technology will be used during the lesson to facilitate motor skill learning. Each lesson will include several small teaching sessions and one individual practice session. Your child will be evaluated multiple times throughout the lesson in order to track his or her progress.

The study will include a pre-test and two post-tests. The pre-test will take place at the beginning of the first lesson, which will evaluate your child’s technique and sight-reading ability. The two post-tests will take place on the fourth and fifth week respectively. Your child will be asked to perform the learned piece for this study. Each post-test will take no more than 5 minutes.

The three lessons and two post-tests will be scheduled before or after your child’s piano lesson or theory classes at USC Center for Piano Studies. All the sessions during this research study will be video recorded and will only be used for educational purposes by the researcher who will analyze the results. The researcher will not use the recording(s) for any other purpose without your additional permission.
Potential Benefits to Participants
Studies in many other fields showed that observing modeling through videos facilitates learners’ acquisition of motor skills. The researcher proposes that observing teacher’s modeling and self-performance through videos may enhance your child’s understanding of specific movement patterns that are required to play a piece. Eventually, it may improve your child efficiency and accuracy of motor performance in piano playing. There are no anticipated risks to your child’s participation.

Practice and Assignment
The researcher encourages your child to practice this piece for this study consistently throughout the week. Daily practice for this piece for 10 minutes is recommended. If daily practice cannot be guaranteed, a minimum of 15 minutes of practice every other day, a total of 45 minutes of practice during the week, should be secured before the next lesson. In addition, skipping two days in a row without practice is not recommended.

Your child will receive an assignment sheet after each lesson. Please complete the practice report with your child. Video modeling with video feedback will be sent to your email account through a private online link during the second and third week. Your child is recommended to watch the videos three times during the week.

Confidentiality
Participation in this study is confidential. A nickname will be assigned to each participant at the beginning of the project. The nickname will be used on project records and no one other than the researcher will be able to link the information with your child. The recordings of the study will be stored digitally in protected computer files owned by the researcher. The results of the study may be published or presented at professional meetings. The researcher may also use the recordings display only your child’s hand for conference presentations, but you or your child’s identity will not be disclosed.

Voluntary Participation
Participation in this study is voluntary. You may withdraw your child from participation in any circumstances during the study. If your child withdraws from this study, the information you have already provided will be stored confidentially as stated above.

Compensation for Participation
You and your child will not be reimbursed for your time and participation in this research study.

Contacts
Feel free to contact the principal researcher, Huiyun Liang at hliang@email.sc.edu or (573) 823-8717 or the research study chairman, Dr. Scott Price at sprice@mozart.sc.edu or (803) 777-1870, or the research co-chair, Dr. Sara Ernst at sernst@mozart.sc.edu or (803) 777-1688 with any questions about the research study.

Parent/Guardian’s Contact Information         Principal Researcher’s Signature
Phone: ______________________  ______________________
Email: ______________________  Date: ____________________
January 15, 2019

Huiyun Liang
Saint Charles, MO 63304

RE: POLKA (from TWENTY-FOUR EASY PIANOPIECES FOR CHILDREN, OP. 39), by DMITRI KABALEVSKY

Dear Huiyun:

This letter is to confirm our agreement for the nonexclusive right to reprint measures from the composition referenced above for inclusion in your thesis/dissertation, subject to the following conditions:

1. The following copyright credit is to appear on each copy made:

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By Dmitri Kabalevsky
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* Mm. 1-8

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3. Permission is granted to University Microfilms, Inc. to make single copies of your thesis/dissertation, upon demand.
4. A one-time non-refundable permission fee of twenty-five ($25.00) dollars, to be paid by you within thirty (30) days from the date of this letter.

5. If your thesis/dissertation is accepted for commercial publication, further written permission must be sought.

Sincerely,

[Signature]

Will Adams
Print Licensing Manager
APPENDIX F

TECHNIQUE EXERCISE FOR PRE-TEST

1. Play the pattern below smoothly (legato touch) in the following sequence:
   1) Right hand alone  2) Left hand alone  3) Hands together (place hands in the neighboring octaves)
   Tempo requirement: quarter note = 72-120

   R.H. Fingering  1  2  3  4  5  4  3  2  1  3  5  3  1  5  1
   L.H. Fingering  5  4  3  2  1  2  3  4  5  3  1  3  5  1  5

2. Play the pattern below with the staccato touch in the following sequence:
   1) Right hand alone  2) Left hand alone  3) Hands together (place hands in the neighboring octaves)
   Tempo requirement: quarter note = 72-120

   R.H. Fingering  1  2  3  4  5  4  3  2  1  3  5  3  1  5  1
   L.H. Fingering  5  4  3  2  1  2  3  4  5  3  1  3  5  1  5
APPENDIX G

PRACTICE ASSIGNMENT

Kabalevsky: “Polka” from 24 Pieces for Children, Op. 39

A. Practice Guideline

- Work on the fluency of individual hands
  - √ Pay attention to L.H. legato lines and breathing motions
  - √ Understand how fingers move in R.H.

- Practice hands together slowly; be able to coordinate different articulation of each hand. Segmented practice is recommended
  - √ Goal Tempo this week: quarter note = 60-72

B. Additional Comments

C. Practice Report

*The form below needs to be completed by a parent or guardian. Day 1 is the lesson day. Put an “X” on the practice row for every day your child has practiced and put an “X” on the use videos row when applicable. Please also write your best estimate of the practice time.

<table>
<thead>
<tr>
<th></th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
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<td>Estimated Time</td>
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<td>Use Videos (Week 2&amp;3)</td>
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164
Kabalevsky: “Polka” from 24 Pieces for Children, Op. 39

A. Practice Guideline

- Work on the articulation of individual hands and focus on the hand movements
  - √ L.H.: connected tones, breathing motions
  - √ R.H.: crisp and light staccato touch
  - √ L.H. and R.H.: Prepare new hand/finger positions accurately in advance

- Practice hands together, be able to coordinate different articulation of each hand. Segmented practice is recommended
  - √ Listen to the balance: projecting L.H. melody while keeping R.H. lightly
  - √ Goal Tempo this week: quarter note = 80-100

B. Additional Comments

C. Practice Report

*The form below needs to be completed by a parent or guardian. Day 1 is the lesson day. Put an “X” on the practice row for every day your child has practiced and put an “X” on the use videos row when applicable. Please also write your best estimate of the practice time.

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</table>
Kabalevsky: “Polka” from 24 Pieces for Children, Op. 39

A. Practice Guideline

Practice left hand and right hand separately

- **L.H. Melody:**
  1) Work on smooth phrases with gentle breathing motions
  2) Work on the dynamics (crescendo and decrescendo in measure 5-8)

- **R.H. blocked intervals (accompaniment):**
  1) Work on the crisp and light staccato touch
  2) Keep the staccato touch consistent

Practice hands together, be able to coordinate different articulation of each hand. Segmented practice is recommended

- Prepare new hand/finger positions accurately in advance
- Listen to the balance: projecting L.H. melody while keeping R.H. blocked intervals lightly
- Goal Tempo this week: quarter note = 120

B. Additional Comments

C. Practice Report

*The form below needs to be completed by a parent or guardian. Day 1 is the lesson day. Put an “X” on the practice row for every day your child has practiced and put an “X” on the use videos row when applicable. Please also write your best estimate of the practice time.

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166
APPENDIX H

RESEARCH ROOM
APPENDIX I

EXAMPLES OF FEEDBACK VIDEOS FOR HOME PRACTICE

Example 1: The blue and yellow circles indicate the original positions of the L.H. thumb and R.H. pinkie. The arrows indicate where the fingers should move in time.

Example 2: The two performances are displayed in a split screen and played one after the other in slow motion. The white circle guides the observer’s attention to the bottom of the video first (expert-modeling), and then to the top of the video (self-modeling).
Example 3: To address some specific issues, such as hand positions or alignment, the researcher froze the video at a certain location during the creation of the feedback videos, added additional text comments, and took a screenshot to save the image.
## Form I: Technique Evaluation Form

<table>
<thead>
<tr>
<th>Hand/Finger Positions</th>
<th>7</th>
<th>6</th>
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- Maintained a rounded and balanced hand position (wrist is level to the keyboard)
- Fingers were securely placed on the corresponding keys
- Played with curved and firmed fingers

### Articulation

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<th>7</th>
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- Produced smooth connections between notes (legato only)
- Produced solid, crispy, and even sound (staccato only)
- Showed smooth wrist motions (legato only)
- Showed proper staccato motions (staccato only)
- Matched the articulation of both hands (hands together only)

### Tempo/Fluency

<table>
<thead>
<tr>
<th>7</th>
<th>6</th>
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</table>

- Played up to the required tempo
- Maintained a steady pulse throughout

## Form II: Sight-Reading Evaluation Form

<table>
<thead>
<tr>
<th>7</th>
<th>6</th>
<th>5</th>
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</table>

- Played with accurate pitches
- Played with accurate rhythms and good sense of meter
- Played with legato connection
- Showed two phrases with breathing
- Prepared new hand positions in advance
- Played forward without hesitation and repetition
- Played fluently with a proper tempo (moderato)
APPENDIX K

EVALUATION FORMS FOR MULTIPLE TESTS AND POST-TESTS

**Evaluation Forms** (multiple tests and post-tests)

**Form III: L.H. Performance**

<table>
<thead>
<tr>
<th>Motor Performance</th>
<th>Tempo</th>
<th>Hand/Finger Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7 6 5 4 3 2 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Maintained a rounded and balanced hand position (wrist is level to the keyboard)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fingers were securely placed on the corresponding keys</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Played with curved and firm fingers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prepared new hand/finger positions accurately in advance</td>
</tr>
</tbody>
</table>

**Articulation**

<table>
<thead>
<tr>
<th>Hand/Finger Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 6 5 4 3 2 1</td>
</tr>
<tr>
<td>• Produced smooth connections between notes</td>
</tr>
<tr>
<td>• Demonstrated smooth wrist motions</td>
</tr>
<tr>
<td>• Shaped nicely and breathed naturally on each phrase</td>
</tr>
<tr>
<td>• Showed proper gesture for the last two notes with tenuto</td>
</tr>
</tbody>
</table>

**Tempo/Fluency**

<table>
<thead>
<tr>
<th>Hand/Finger Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 6 5 4 3 2 1</td>
</tr>
<tr>
<td>• Played up to the performance tempo (120 bpm)</td>
</tr>
<tr>
<td>• Made a steady pulse throughout</td>
</tr>
<tr>
<td>• Played forward without hesitation and repetition</td>
</tr>
</tbody>
</table>

**Form IV: R.H. Performance**

<table>
<thead>
<tr>
<th>Motor Performance</th>
<th>Tempo</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td>7 6 5 4 3 2 1</td>
</tr>
<tr>
<td>• Maintained a rounded and balanced hand position (wrist is level to the keyboard)</td>
<td></td>
</tr>
<tr>
<td>• Fingers were securely placed on the corresponding keys</td>
<td></td>
</tr>
<tr>
<td>• Played with curved and firm fingers</td>
<td></td>
</tr>
<tr>
<td>• Prepared new hand/finger positions accurately in advance</td>
<td></td>
</tr>
</tbody>
</table>

**Articulation**

<table>
<thead>
<tr>
<th>Hand/Finger Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 6 5 4 3 2 1</td>
</tr>
<tr>
<td>• Produced solid and crisp staccato sounds</td>
</tr>
<tr>
<td>• Demonstrated proper staccato motions</td>
</tr>
<tr>
<td>• Played staccato notes evenly in terms of dynamic and length</td>
</tr>
<tr>
<td>• Played smooth connection for two-note slur in mm.8 and indicated properly for the note with tenuto</td>
</tr>
</tbody>
</table>

**Tempo/Fluency**

<table>
<thead>
<tr>
<th>Hand/Finger Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 6 5 4 3 2 1</td>
</tr>
<tr>
<td>• Played up to the performance tempo (120 bpm)</td>
</tr>
<tr>
<td>• Maintained a steady pulse throughout</td>
</tr>
<tr>
<td>• Played forward without hesitation and repetition</td>
</tr>
</tbody>
</table>

**Other Aspects of Performance**

<table>
<thead>
<tr>
<th>Hand/Finger Positions</th>
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</thead>
<tbody>
<tr>
<td>7 6 5 4 3 2 1</td>
</tr>
<tr>
<td>• Played with accurate pitches</td>
</tr>
<tr>
<td>• Played with accurate rhythm</td>
</tr>
<tr>
<td>• Played medium soft</td>
</tr>
<tr>
<td>• Indicated the harmonic progression through dynamics</td>
</tr>
<tr>
<td>• Played musically with proper character</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hand/Finger Positions</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 6 5 4 3 2 1</td>
</tr>
<tr>
<td>• Played with accurate pitches</td>
</tr>
<tr>
<td>• Played with accurate rhythm</td>
</tr>
<tr>
<td>• Played medium soft</td>
</tr>
<tr>
<td>• Indicated the harmonic progression through dynamics</td>
</tr>
<tr>
<td>• Played musically with proper character</td>
</tr>
</tbody>
</table>
### Evaluation Forms (multiple tests and post-tests)

#### Form V: H.T. Performance

**Motor Performance**

**Tempo _____**

<table>
<thead>
<tr>
<th>Hand/Finger Positions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7 6 5 4 3 2 1</td>
<td>Maintained a rounded and balanced hand position (wrist is level to the keyboard)</td>
</tr>
<tr>
<td>7 6 5 4 3 2 1</td>
<td>Both hands' fingers were securely placed on the corresponding keys</td>
</tr>
<tr>
<td>7 6 5 4 3 2 1</td>
<td>Played with curved and firmed fingers</td>
</tr>
<tr>
<td>7 6 5 4 3 2 1</td>
<td>Prepared new hand/finger positions accurately in advance</td>
</tr>
</tbody>
</table>

**Articulation**

| 7 6 5 4 3 2 1 | Produced smooth connections between notes (L.H.) |
| 7 6 5 4 3 2 1 | Demonstrated smooth wrist motions (L.H.) |
| 7 6 5 4 3 2 1 | Shaped nicely and breathed naturally on each phrase (L.H.) |
| 7 6 5 4 3 2 1 | Showed proper gesture for the last two notes with tenuto (L.H.) |
| 7 6 5 4 3 2 1 | Produced solid and cripsy staccato sound (R.H.) |
| 7 6 5 4 3 2 1 | Demonstrated proper staccato motions (R.H.) |
| 7 6 5 4 3 2 1 | Played staccato notes evenly in sound and articulation (R.H.) |
| 7 6 5 4 3 2 1 | Played smooth connection for two-note slur and showed proper gesture for the tenuto marking in measure 8 (R.H.) |

**Hand Coordination**

| 7 6 5 4 3 2 1 | Coordinated properly between R.H. and L.H. (legato motions against staccato motions) |
| 7 6 5 4 3 2 1 | Coordinated properly in measure 8 while demonstrating nice hand gestures for both hands |

**Tempo/Fluency**

| 7 6 5 4 3 2 1 | Played up to the performance tempo (120 bpm) |
| 7 6 5 4 3 2 1 | Maintained a steady pulse throughout |
| 7 6 5 4 3 2 1 | Played forward without hesitation and repetition |

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#### Other Aspects of Performance

**Pitch/Rhythm Accuracy**

| 7 6 5 4 3 2 1 | Played with accurate pitches |

| 7 6 5 4 3 2 1 | Played with accurate rhythm |

**Balance/Dynamics**

| 7 6 5 4 3 2 1 | Played with nice balance (medium loud for L.H. and medium soft for R.H.) |

| 7 6 5 4 3 2 1 | Showed nice shapes of the phrases by using proper dynamics |

**Artistry**

| 7 6 5 4 3 2 1 | Played musically with proper character |
APPENDIX L

PRE-TEST RESULTS

1) Technique Test

<table>
<thead>
<tr>
<th>Technique</th>
<th>Legato</th>
<th>Staccato</th>
<th>Average %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
<td>H.T.</td>
</tr>
<tr>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
<td>H.T.</td>
</tr>
<tr>
<td>Tempo=72</td>
<td>67.35%</td>
<td>69.39%</td>
<td>67.86%</td>
</tr>
<tr>
<td>Tempo=120</td>
<td>59.18%</td>
<td>53.06%</td>
<td>58.93%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technique</th>
<th>Legato</th>
<th>Staccato</th>
<th>Average %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
<td>H.T.</td>
</tr>
<tr>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
<td>H.T.</td>
</tr>
<tr>
<td>Tempo=72</td>
<td>67.35%</td>
<td>63.27%</td>
<td>67.86%</td>
</tr>
<tr>
<td>Tempo=120</td>
<td>53.06%</td>
<td>59.18%</td>
<td>64.29%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technique</th>
<th>Legato</th>
<th>Staccato</th>
<th>Average %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
<td>H.T.</td>
</tr>
<tr>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
<td>H.T.</td>
</tr>
<tr>
<td>Tempo=72</td>
<td>40.82%</td>
<td>40.82%</td>
<td>39.29%</td>
</tr>
<tr>
<td>Tempo=120</td>
<td>36.73%</td>
<td>40.82%</td>
<td>46.43%</td>
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<table>
<thead>
<tr>
<th>Technique</th>
<th>Legato</th>
<th>Staccato</th>
<th>Average %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
<td>H.T.</td>
</tr>
<tr>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
<td>H.T.</td>
</tr>
<tr>
<td>Tempo=72</td>
<td>65.31%</td>
<td>67.35%</td>
<td>66.07%</td>
</tr>
<tr>
<td>Tempo=120</td>
<td>67.35%</td>
<td>63.27%</td>
<td>60.71%</td>
</tr>
<tr>
<td>Sophia Technique</td>
<td>Legato</td>
<td>Staccato</td>
<td>Average %</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------</td>
<td>-----------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>R.H.</td>
<td>L.H.</td>
<td>H.T.</td>
</tr>
<tr>
<td>Tempo=72</td>
<td>63.27%</td>
<td>57.14%</td>
<td>66.07%</td>
</tr>
<tr>
<td>Tempo=120</td>
<td>57.14%</td>
<td>57.14%</td>
<td>58.93%</td>
</tr>
</tbody>
</table>

2) Sight-Reading Test

<table>
<thead>
<tr>
<th>Sight-Reading Percentage</th>
<th>Amy</th>
<th>Charles</th>
<th>Ella</th>
<th>Nicholas</th>
<th>Sophia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>69.39%</td>
<td>57.14%</td>
<td>42.86%</td>
<td>48.98%</td>
<td>59.18%</td>
</tr>
</tbody>
</table>
APPENDIX M

ELLA’S PERFORMANCE PROGRESS

Ella’s left-hand progress: MP.

Ella’s left-hand progress: MP and OP.

Ella’s right-hand progress: MP.

Ella’s right-hand progress: MP and OP.