THE EFFECT OF SEQUENCED ACCOMPANIMENTS ON RHYTHMIC ACCURACY AND PLAYING FLUENCY OF BEGINNER PIANO STUDENTS AGED SIX TO EIGHT

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CULTURAL CENTRE
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Field of Study: Music Education

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THE EFFECT OF SEQUENCED ACCOMPANIMENTS ON RHYTHMIC ACCURACY AND PLAYING FLUENCY OF BEGINNGER PIANO STUDENTS AGED SIX TO EIGHT

ABSTRACT

This research study aims to examine beginning piano students' rhythmic accuracy and playing fluency in each of the two conditions: with and without the use of sequenced accompaniments during piano teaching through quasi-experimental design. Subjects (N=60) of six to eight years old beginning piano students were randomly assigned to treatment group and control group. Subjects were tested on piano pieces of two different styles: March and Swing, with selected rhythmic components. Subjects in the treatment group were taught to practise six rhythm exercises with sequenced accompaniments, while the other group was taught to practise the same rhythm exercises without sequenced accompaniments. Sequenced accompaniments has shown to be effective in increasing rhythmic accuracy and playing fluency of beginning piano students, with a significant difference statistically between the two groups, $p < 0.001$ for both Piece A and Piece B. Sequenced accompaniment teaching approach was proven to be a universal approach across all ages (from six to eight years old) whereas the conventional rhythm counting method is only suitable for the later age group. The findings of this research study suggested that sequenced accompaniments are effective in music teaching, which fit the cognitive processes of music learning in young children, rather than merely providing fun experiences. The outcome of this experimental research provides new insight in rhythm training for music educators and contributes to the research gaps identified within music technology education research, as well as piano or digital keyboard manufacturing industries in developing new technologies or products to ensure musical growth.

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Keywords: technology in music education, sequenced accompaniments, rhythm training approach

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KESAN IRINGAN BERTURUTAN TERHADAP KETEPATAN IRAMA DAN KECEKAPAN BERMAIN BAGI PELAJAR-PELAJAR PERMULAAN PIANO BERUMUR ENAM HINGGA LAPAN TAHUN

ABSTRAK

Kajian penyelidikan ini bertujuan untuk menilai ketepatan irama dan kecekapan bermain bagi pelajar permulaan piano berdasar pada dua syarat: dengan penggunaan iringan berturutan atau tanpa penggunaan iringan berturutan semasa mengajar, melalui reka bentuk eksperimental kuasi. Subjek (N = 60) yang terdiri daripada pelajar permulaan piano berumur enam hingga lapan tahun dibahagikan secara rawak kepada kumpulan rawatan dan kumpulan kawalan. Subjek diuji berdasarkan dua lagu piano dengan stail muzik yang berbeza; iaitu *March* dan *Swing*, diiringi dengan komponen-komponen irama terpilih. Subjek-subjek dalam kumpulan rawatan dilatih untuk bermain enam latihan irama dengan iringan berturutan, manakala kumpulan yang satu lagi dilatih untuk bermain latihan-latihan irama yang sama tanpa iringan berturutan. Iringan urutan telah terbukti berkesan dalam meningkatkan ketepatan irama dan kecekapan bermain pelajar permulaan piano, dengan perbezaan yang signifikan secara statistik antara dua kumpulan, $p < 0.001$ untuk kedua-dua Lagu A dan Lagu B. Pendekatan pengajaran dengan menggunakan iringan berurutan telah terbukti merupakan pendekatan universal pada semua peringkat umur (dari enam hingga lapan tahun) manakala kaedah konvensional secara penghitungan irama hanya sesuai untuk kumpulan pelajar yang lebih tua. Penemuan kajian penyelidikan ini mencadangkan bahawa penggunaan iringan berturutan adalah berkesan dalam pengajaran muzik, dimana kaedah ini bersesuaian dengan proses kognitif pembalajaran muzik pada kanak-kanak, dan bukan sekadar memberikan pengalaman yang menyeronokkan sahaja. Hasil penyelidikan experimen ini memberi penemuan baru dalam latihan irama untuk golongan pendidik muzik dan menyumbang kepada mengurangkan jurang penyelidikan yang telah dikenal pasti dalam penyelidikan pendidikan teknologi muzik. Hasil penyelidikan ini juga

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menyumbang kepada industri pembuatan piano atau keyboard digital dalam penghasilan teknologi atau produk baru untuk memastikan pertumbuhan muzik.

Kata kunci: teknologi dalam pendidikan musik, iringan berturutan, pendekatan latihan irama

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CHAPTER 1: INTRODUCTION

1.1 Background

Music learning has changed profoundly over the past twenty years with the emergence of digital technologies and multimodal literacies (Kress, 2010). Many researchers have explored numerous ways of integrating music technologies into music instrument instruction (e.g., Rudolph, 2004; Williams & Webster, 2006; Watson, 2011; Webster, 2011). Even though fundamentals of music teaching remain the same with or without music technology, music technology has the potential to enhance the quality in music education, as well as help learners overcome technical difficulties related to instrumental performance (Savage, 2007).

Integration of sequenced accompaniment in the form of digital audio compact disc (CD) or musical instrument digital interface (MIDI) recordings into beginning piano method books is gaining popularity in today's piano teaching. With advance technology development, some educators have even developed MIDI recordings in the form of mobile applications for easy use and studio convenience. Brittin (2001) surveyed on effects of sequenced accompaniments on children's music preferences and recommended that if children are to be engaged in classroom teaching, instruments with sequenced accompaniments function, such as electronic keyboards, which are relatively cost effective and user-friendly is recommended.

Since electronic keyboard and MIDI technology came onto the market in the 1980s, they have gained popularity among teachers in music education. Although some people might think electronic keyboard is just a toy, it has developed into a recognised standard instrument in music education especially for young beginners (Marsden, 2013b). Most electronic keyboards come with auto-accompaniment features, and a wide range of sounds and rhythm backing styles, which can be a potential tool for acquiring musical

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knowledge (Rudolph, 2004). Rhythm units in electronic keyboards can be used to train young children with basic rhythm patterns and cultivate the feeling of music pulse.

Rhythm is unquestionably one of the principal elements in piano learning. A musician's performance accuracy is closely related to their rhythmic abilities. Beat, which is the steady, repeating pulse, serves as a framework for students to organize musical rhythms (Drake & Gerard, 1989). Since most keyboards offer basic facilities including a rhythm unit which can produce set rhythmic patterns, maintain a steady pulse and operate at different tempi, it is a potential tool to build rhythm foundation in piano students.

Sequenced accompaniment, or MIDI accompaniment, which can be easily arranged using electronic keyboard, mimics an ensemble environment for pianists. One of the problems faced by piano students nowadays is the ability to perform with fluency. This is because students are often taught to play repertoire in a solo manner. Lack of fluency during performance certainly affects performance accuracy and continuity. Uszler, Gordon, and Smith (2000) mentioned that, "To experience rhythm is the core of listening to music as well as making it. Rhythm is a physical sensation, easier to feel than to describe" (p. 8). Piano teachers or educators can possibly adopt sequenced accompaniments to create external rhythmic stimuli and increase student's enjoyment in piano classes (Lancaster & Renfrow, 2004). In other words, sequenced accompaniments can be used to cultivate the feel of pulse and internalise the sense of rhythm in beginning students, which cannot be achieved easily through music notation itself (Ajero, 2007). Appropriate adoption and formalisation of the use of music technologies such as electronic keyboard and MIDI function as mentioned above can bring music education into a higher level.

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1.2 Problem Statement

Teaching rhythmic concepts to beginner piano students aged six to eight can be challenging among piano teachers. With the emergence of music technologies, integration of sequenced accompaniments into rhythm teaching should be explored and examined.

Quantitative research study in the effects of sequenced accompaniments on piano performance is limited, especially on beginning piano students of young children aged six to eight years old.

1.3 Significance of The Research

Rhythmic accuracy and playing fluency are basic goals in piano instruction. The use of keyboard technology through sequenced accompaniments potentially can assist teachers to achieve this goal with their students. However, research in the effects of sequenced accompaniments on young children's piano performance is scarce, especially students aged six to eight in an individual piano instruction setting. Therefore, more empirical research is needed to determine if sequenced accompaniments is effective towards piano performance accuracy in children aged six to eight.

The outcome of this study provides a new insight for piano teachers in their rhythm teaching process, especially in using keyboard technology on improving students' rhythm accuracy and playing fluency. It also benefits piano or digital keyboard manufacturing industries in developing new technologies or products to ensure musical growth.

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1.4 Research Objectives

Research Objective 1: To compare rhythmic accuracy and playing fluency test score of participants aged six to eight practicing with sequenced accompaniments and with the use of conventional rhythm counting method.

Research Objective 2: To identify if Swing style sequenced accompaniment may help young children in learning difficult rhythm patterns such as syncopation.

Research Objective 3: To identify the effect of different performance conditions (with or without backing track; Swing or March style sequenced accompaniment) to the rhythmic accuracy of participants.

1.5 Research Questions

The research questions focus on the effectiveness of keyboard technology through sequenced accompaniments based on the subjects' rhythmic accuracy and playing fluency scores.

Research Question 1: How does rhythmic accuracy test score and playing fluency test scores of participants practicing with sequenced accompaniments compare to rhythmic accuracy and playing fluency test scores of participants practicing with conventional rhythm counting method?

Sub-Research Question 1.1: How does rhythmic accuracy test scores of participants practicing with sequenced accompaniments compare to rhythmic accuracy test score of participants practicing with conventional rhythm counting method?

Sub-Research Question 1.2: How does fluency errors of participants practicing with sequenced accompaniments compare to fluency errors of participants practicing with conventional rhythm counting method?

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Sub-Research Question 1.3: Are children's age groups affected rhythmic accuracy test scores of participants practicing with sequenced accompaniments compare to rhythmic accuracy test score of participants practicing with conventional rhythm counting method?

Research Question 2: Will characteristics of a Swing style in sequenced accompaniment aid young children in learning syncopated rhythm pattern?

Research Question 3: Will performance conditions (with or without backing track; March style and Swing style) during performance affect the rhythmic accuracy of participants practicing with sequenced accompaniments?

Sub-Research Question 3.1: Will playing with or without backing tracks during performance affect the rhythmic accuracy of participants practicing with sequenced accompaniments?

Sub-Research Question 3.2: Will exchange of backing track with different music style (March style and Swing style) affect rhythmic accuracy test scores of participants practicing with sequenced accompaniments?

1.6 Definition of Terms

Rhythmic Accuracy – Rhythmic accuracy was defined as how accurate each note value to make up a rhythm pattern for each of the bars. Rhythm is considered accurate when notes are played with consistent tempo within each bar, with notes correctly proportioned to each other in relation to the beat provided.

Playing fluency – Playing fluency was defined as fluency errors where disruption to the pulse (pauses, hesitations, repetitions or abrupt change in tempo) occurred during performance.

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Sequenced Accompaniment – Sequenced accompaniment is defined as sequenced MIDI channels which include additional instruments that may provide harmonic textures, countermelodies, and percussive rhythmic accompaniments. In this research, sequenced accompaniment was directly synthesized using electronic keyboard workstation and edited and compressed into audio file using digital audio workstation (DAW) application on iPad.

1.7 Research Framework

This research on integration of music technology into piano pedagogy is based on the proposed theoretical or conceptual framework by Mishra and Koehler (2006). The research was divided into two stages: research planing and experimental procedure testing to test the methodology based on Ajero (2007) and Schwinger (2015), and experimental stage for data collection and analysis. Figure 1 shows the overall framework of this research study.

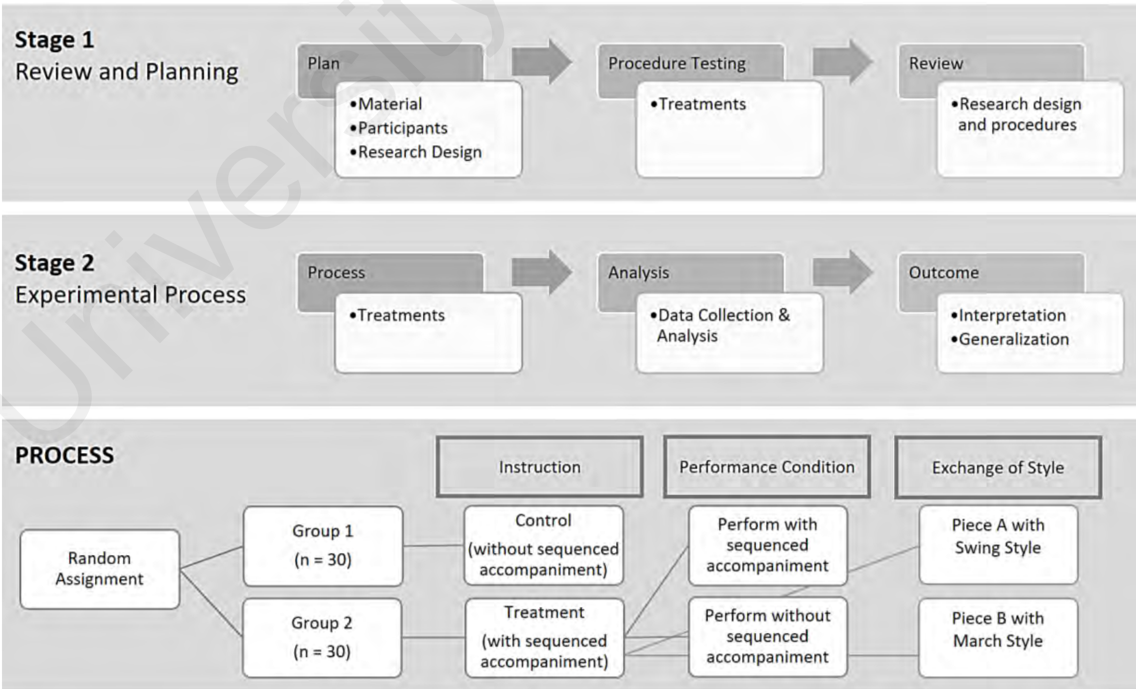

Figure 1: Research framework

Hypotheses of this research study were as follow:

Hypothesis 1 – The use of sequenced accompaniments during practice significantly affect the rhythmic accuracy of beginning piano students' performance aged six to eight rather than practice by just adopting the conventional rhythm counting method.

Hypothesis 2 – The use of sequenced accompaniments during practice significantly affect the playing fluency of beginning piano students aged six to eight rather than practice by just using the conventional rhythm counting method.

Hypothesis 3 – There is a significant interaction between practicing treatments and participants age groups.

Hypothesis 4 – The use of sequenced accompaniment with Swing style during practice significantly improves rhythmic accuracy test scores of syncopated rhythmic patterns.

Hypothesis 5 – The use of backing track during performance significantly affect the rhythmic accuracy of participants compared to performance without backing track.

Hypothesis 6 – There is a significant relationship between pieces and styles of backing track (March style and Swing style) during performance during posttest.

All the mentioned hypotheses were assessed at a significance level of $\alpha = 0.05$.

1.8 Delimitation

This research was only limited to beginner children aged six to eight, and with only piano learning experience of one year or less. In Malaysia, children usually start their one-to-one piano lesson at the age of six to eight. Therefore, it is best to explore the use

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of sequenced accompaniments in teaching rhythm to children of this age group. Gender was not specified in this research study.

The research only focused on beginner piano students with piano learning experience of one year or less. This was to limit the influence of other rhythm learning methods that would have instilled in children prior to participating this research study. One year or less piano playing experience of participants would benefit this study. Participants with basic piano playing skills would aid in accelerating the research study time frame. The researcher would not need to teach children on piano playing basic skills such as finger positions and notes reading.

Two piano compositions with two different music styles were taught and rehearsed to maintain the consistency of teaching and learning of both control and treatment groups.

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CHAPTER 2: LITERATURE REVIEW

This section provides a summary of background and research literatures on digital technology in music education, misconceptions of teaching with technology, technology competency and professional development for teachers in the applications of music technology in music education, electronic keyboard technology and usage of sequenced accompaniments in music education, establishment of rhythmic concept in young children, auditory modelling, audio-visual approach in relation to performance accuracy, as well as criteria performance accuracy is assessed in past research.

2.1 Integration of Digital Technology into Music Education

The advent of digital technology has changed all aspects of our life. Generally, technology is a term used to define anything that adopts science to reach for an aim or positive outcome (Rudolf, 2004). However, the uses of technology in this research study refers to the most recently invented devices such as computers, electronic keyboards, MIDI technology and mobile devices. Mishra & Koehler (2006) mentioned that technology integration, which is the act of including technology in teaching, is no longer a new phenomenon in educational context. Incorporating technology into music teaching and learning has also become common over the past forty years.

Music technology is defined as the use of electronic technology to control, manipulate or communicate musical information (Murray, 1997, as cited in Pitt & Kwami, 2002, p. 61). It is also used to "help humans produce, enhance and better the area of sound organised to express feeling" (Webster, 2002, p. 416). According to Rudolph *et al.* (2005), The Technology Institute for Music Educators (TI:ME), has divided technology into seven areas: Electronic instruments, music notation software, MIDI/ digital audio sequencing, instructional software, telecommunications and the

Internet, multimedia and digital media and information processing and laboratory management.

Rudolf (2004) also summarized several key findings from a research relating to music education and the use of technology conducted by Yamaha Corporation. These include:

- Student attitudes toward classroom music are not only positively enhanced, but levels of interest and motivation are sustained across multiple academic years.
- Long and short-term music achievement, as evidenced in standardized tests, is significantly increased when compared to existing approaches of classroom music.
- Students who received hands-on instruction had greater comprehension of musical concepts compared with students taught with traditional approaches and methods.
- Music instruction provided through a technology assisted programme contributes to a sense of professional development and personal growth on the part of the music educators.
- Additional outcomes of the study showed that technology improved student's concentration, maximized time on-task, developed and enhanced cooperative learning, and fostered higher level thinking skills. Classroom teachers and building administrators noted that these aspects were carried over to learning in non-music classrooms. (Rudolf, 2004, p. 5)

Reese (2002) mentioned that incorporation of technology into traditional music instruction has been a steady but slow process. Technology integration was also focused more on general music teaching than on instrument performance teaching (Dammers,

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2012; Jinright, 2003; Reese, 2002). As discussed in the framework for teacher knowledge on technological pedagogical content by Mishra and Koehler (2006), they mentioned that educators are often bias towards technologies, and judge the suitability of adopting technologies by their own preferences. Knowledge behind what teachers need to know in order to appropriately incorporate digital technology into their teaching is vague. Most music teachers are afraid of the availability of the instruments or space, or lack of knowledge on using the technology effectively with students.

The proposed framework by Mishra and Koehler (2006) for pedagogy and technology integration – Technological Pedagogical and Content Knowledge (TPACK), could become a guide for future music education technology research and curriculum development works. This framework has been applied in various research on technological skill evaluation and support (Colvin & Tomayko, 2015; Fisser, Voogt, van Braak, & Tondeur, 2015). Dorfman (2013) cited TPACK as one of the guidance in designing technology-based music instruction.

Music educators must keep in mind that most of their students come from the generation of "Digital natives" who are born after 1980 that are competent in using networked digital tools (Gouzouasis & Bakan, 2011; Palfrey & Gasser, 2010; Prensky, 2011). Even though most of the music educators are considered "digital immigrants", who are not born into development phases of digital tools, they should keep up with the current technological advancement in their profession.

When adopting such technologies or tools, we must understand that music teaching or learning always take priority over the technology (Carr *et al.,* 1998; Mishra & Koehler, 2003). The main purpose of learning should not be diverting from music to the technology tool itself. With appropriate understanding of the mentioned principle, music

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technology can definitely help in promoting musical understanding. In order to comprehend new directions and the future of music education, Madsen stated:

> Music educators need to be proficient and knowledgeable concerning technological changes and advancements and be prepared to use all appropriate tools in advancing music study while recognizing the importance of people coming together to make and share music. (Madsen, 2000)

Mobile technologies such as smart phones, iPods and tablet computers have expanded the way people engage with music (Bauer, 2014a). Besides the large storage space of mobile equipment as mentioned above, cloud storage through WiFi or cellular data connections also allow access of recorded compositions anytime, anywhere. Mobile applications (apps) has also changed the way people create, perform, learn and teach music.

Exposure of technology and interactive media is widespread among young children in today's society. In the survey carried out by Rideout (2013), he found that children aged 0-2 that have used a mobile device for media activity has increased from 39% in 2011 to 80% in 2013. Lack of research in educational benefits of music-based tablet apps for young children has led Burton & Pearsall (2016) to examining the preferences of young children on music-based apps in preschool. They advised that understanding of music apps in relation to promoting musical responses may help developers in creating music-based technology that benefits music education for young children.

While current in-trend video hosting services such as YouTube, mobile applications and other multimedia are widespread in music education; augmented-reality (AR) could be the future of music learning. Chow *et al.* (2013) studied on the how augmented-reality experience could improve the efficacy of piano learning by using a head

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mounted display connecting to a computer system. They have received a positive feedback from seven beginner piano students participated in their study. Augmented reality functions as a potential technology in creating a more direct interaction between the student and the system, where student can view the real world with virtual objects superimposed upon them (Azuma, 1997).

2.2 Misconceptions of Teaching with Technology

It is commonly recognised that integration of technology in music education is holding a great promise. However, technology has still been rejected by some educators (Mishra and Koehler, 2006; Sheninger, 2012; Williams and Webster, 2006). Common misunderstandings of educators towards technology are reviewed, analysed and summarised in this section.

TouchApp Limited (2015), a mobile and web development company, which is a web apps provider for mobile and web users focusing in education, discussed that misconceptions of teaching with technology are commonly focused on four main aspects; educators view technology as an expensive investment, difficult to use, time consuming and issues with security which will distract children and hinder their learning.

Sheninger (2012) also discussed common misunderstandings among educators on technology. He summarised that misconceptions are often relating to time, cost, assessment, control and lack of training, which create fears among educators thus preventing educators from creating a more student-centered, innovative learning culture.

Williams and Webster (2006) listed ten misconceptions of educators specifically in music education field. Educators focused more on hardware such as computers and electronic keyboards when referring to technology. In fact, technology involves users

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and procedures, data and its processing software, and lack of knowledge on the built of hardware should not prevent one from incorporating technology in their teaching. Besides literacy on technology usage, digital technology is also viewed as expensive investment and time consuming. Educators fear that technology will remove creativity in music learning, where musicians spend more time into engaging technology instead of music itself. Some refuse technology in fear that it will replace their jobs and affect employment opportunities.

Educators often over-look the benefits of integrating music technology in teaching. Digital format instead of printed books are more environmental friendly, and even reduce costs of printing. Newly emerged technological tools such as iPad which is equipped with user-friendly interfaces can be a replacement to older complex computer software.

All of the discussed misconceptions promote fear among music educators which hinder the adaption of educational technology. Music educators should avoid making rush judgement and should only develop their opinions after various experiments and experiences.

2.3 Technology Competency and Professional Development for Teachers in the Application of Music Technology in Music Education

Even until recently, there are still quite a high percentage of music teachers who feel that they are not prepared to effectively use technology in teaching. Haning (2015) carried out a survey on preservice music teachers ($N = 46$) in Ohio regarding technology instruction in music teacher education programmes. He reported that 63% of respondents reported to have taken a music technology class, whereas 43% of teachers indicated that they were not ready to incorporate technology in their music class.

Reese and Rimington (2000) mentioned that 83% of music teachers had experienced some computer training in Illinois public schools, but about 60% of them rated their expertise in music technology as “average” or “below average”. Reese and Rimington (2000) therefore concluded that “until structured, organized training becomes generally available, strategies should support teachers in the pursuit of self-guided learning” (p. 31).

Leong (1995) carried out a survey on music technology competency and effective teacher preparation among primary teachers in Western Australia, and reported that only 11% of primary school teachers indicated that they have had adequate training on the use of technology with confidence and competence. He summarized that, one of the reasons technology was not used in music teaching was due to lack of expertise and lack of confidence among music teachers in Western Australia.

In New South Wales, Australia, only 34% of teachers was trained in music technology in their pre-service teacher education programmes (Merrick, 1995). From the population surveyed, less than half (46%) of teachers were using music technology in class. Three quarter of the teachers surveyed indicated that their overall computer literacy was within the range from “satisfactory” to “very limited”. Merrick (1995) suggested music technology, both at technical and educational level, needs to become “a mandatory part of all pre-service music education courses” (p. 195) in order to develop an understanding of technology-based teaching and learning among music teachers.

In Malaysia, literature on the development and status of incorporating technology in music education is limited. Hasnizam (2005) discussed possibilities of incorporating music technology in primary, secondary and tertiary education in Malaysia, focusing on sharing his experiences in setting up music technology courses and facilities in early 1996, and Electro-Acoustic Group (EAG) in 1997 in Universiti Malaysia Sarawak. He

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also reviewed problems faced in promoting music technology to students with no music background, and allowed them to be trained to become professional music technologist.

2.4 Electronic Keyboard Technology and Sequenced Accompaniment in Music Education

Electronic keyboard has gained its popularity at home, school, private music lesson and even on-stage performance. Many resources that were published also acclaimed the usefulness of electronic keyboards in music education (Appell, 1993; Chamberline, Clark, & Svengalis, 1993; Renfrow, 1995; Rudolph, 1993; Wiggins, 1993). Classroom teachers and performance groups found that electronic keyboards to are more portable and affordable than traditional acoustic pianos. It has also been used as a teaching tool by music teachers to support music knowledge and raises creativity (Appell, 1993). Electronic keyboards can also be equipped with computers and used for computer-assisted instruction (CAI) in electronic instrument laboratories in schools and universities (Rudolph, 1993). Revolution of group piano classes started after the development of electronic keyboards. With the introduction of headsets, electronic keyboards also turned group piano classes into reality (Goltz, 1975). This allows students to practice on a specific task individually during class without interrupting other students. With such designs, electronic keyboard is a potential equipment to offer a new dimension to the teaching and studying of music.

Electronic keyboards can be divided into five types: basic electronic keyboard, performance synthesizers, digital piano, sampler, and workstations. With the increasing market demand in this era, many hybrid keyboards with mixture of mentioned types are made available. All electronic keyboards are equipped with hundreds of accompaniment styles such as march, waltz, reggae, tango, disco and so on. Styles (or Rhythm, depending on the manufacturer) consist of a drum track, which are repeated rhythms in

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a style or continuous loop that will go on playing until it is stopped at a touch of a button. Playing different chords aligned with a music piece together with a selected Style and ACMP (short for accompaniment) will provide a sequenced accompaniment sampler with a full harmonic backing. Full harmonic backing will provide a music band condition or environment; drum tracks in another way is useful to keep students in time. Therefore, electronic keyboard is considered very user-friendly with the increased options described above (Brittin, 2000).

Workstations, a hybrid keyboard that combines several functions, is particularly useful in music education. Besides being used as a performance instrument, it is also functioned as a MIDI controller, and is equipped with MIDI sequencer and storage device such as USB ports for storing sequences (Rudolf, 2004). This development of technology is particularly important to researchers and music educators in research works and teaching.

MIDI protocol between keyboards and computers has only emerged in the early 1980s. Prior to incorporating MIDI into music teaching and learning, studies on the effects of live accompaniments and accompaniments on pre-recorded tape which is similar to the nature of MIDI accompaniments were studied. Bauer (2014b) mentioned that audio accompaniments used for practice can be generated using notation and sequencing software, and be made available on compact discs as a supplement to many method books. Many piano method books also provide MIDI accompaniments for their pedagogical pieces with the aim to increase students' enjoyment during lessons and practice sessions, and more importantly, to provide students with rhythmic support (Lancaster & Renfrow, 2004).

MIDI sequences format is preferred over other types of media such as audio CDs because of the flexibility in adjusting tempo to suit the student's speed in playing a

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piece (Litterst, 2003). Key transposition, changing instrument voices and adjusting dynamic levels are also possible with MIDI format. One can also mute or isolate certain tracks, and create a loop to repeatedly playing a certain selected section. MIDI accompaniment can be easily recorded using an electronic keyboard and transferred to a digital audio workstation (DAW) to be edited for teaching purposes.

The *Music IT Pack* (NCET, 1997) suggested that music-specific peripherals in teaching and learning sequencing and scoring required the equipment as such:

- MIDI interface and MIDI keyboard (for MIDI sequencing)
- MIDI interface, MIDI keyboard and MIDI sound module (for MIDI sequencing an external sound source (NCET, 1997, p. 7).

Electronic keyboard paired with MIDI technology has been used for creative activities in music teaching and learning. The combination of these technologies allows students to record melodies, chords, and accompaniments on different tracks. It also boosts their creativity where changing of voices and effects, adding countermelodies, introduction, extensions and improvisations are possible with MIDI integrated electronic keyboards (Pearsall, 2008). Schender (1998) also mentioned that electronic keyboards and MIDI technology are tools to enhance creativity and motivation in group piano students.

Since the emergence of music technology, researchers have been studying effects of sequenced accompaniments towards children. A study was carried out by Brittin (2000) to examine children's preference for sequenced accompaniments and their connection between style and perceived tempo. Children's listening preference has played an important role in music curricular planning. A total of 343 students (Grade two to grade six) were examined on their musical style preference and tempo perception. Ten

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accompaniment styles, including one with simple chords representing acoustic piano accompaniment were played to the children. The survey concluded that children preferred Hip-Hop, Heavy Rock Shuffle, Samba, and Funk2 styles; Polka, March, Bluegrass, and Piano Chords, in contrary, were least preferred. No significant relationship was found between perceived faster tempo and style preference for children in second grade, whereas significant correlation was found in children in other grades.

Brittin (2001) studied preferences for children's music through effects of sequenced accompaniments, school culture and media association. A total of 463 children in third- and fourth- grade from suburban school district and urban district were surveyed for their preference of songs played over nine different auto-accompaniment styles and piano accompaniment. The study concluded that all children were positive towards most of the sequenced accompaniment styles, and piano chord accompaniments were not preferred by both groups. This implies that if children are to be engaged in classroom teaching, instruments with sequenced accompaniments function, such as electronic keyboards, is recommended.

Besides primary school children, Brittin (2002) also surveyed a total of 188 instrumentalists from middle school and high school (grade six to twelve) on student perceptions of performance quality when compact disc accompaniments were used, compared to simple piano accompaniments and solo setting. Students were asked to rate the performance quality of the recordings in conditions mentioned above, and to specify the performance's best feature and aspect needing most improvement. The results of this study showed that CD accompaniments were the most preferred among school students. Younger students were most influenced by the accompaniment condition, particularly popular music styles. The analyses also showed that there was a significant correlation between accompaniment style preference and performance quality ratings.

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Thus, it was suggested that teachers should provide different accompaniment conditions for motivational impact and at the same time maintain the student's perception of performance quality.

Faber Piano Adventures®, a popular piano method book, claimed that their supplemented background accompaniments provided in the form of Audio CD, MIDI format or Mobile Applications, serve as exploratory environments instructional multimedia. Three goals of background accompaniments are mentioned:

- To improve rhythmic accuracy in rhythmic practice. Students will be able to feel the beat and the sense of musical flow based on the time signature, which cultivate playing fluency.
- Sequenced accompaniment provides suitable musical environment to improve sight reading.
- Variety of musical styles such as chamber orchestra, marching band, rock band, jazz ensemble, etc. with orchestrated interpretation serves to inspire children to play with rhythmic vitality, forward motion, and musical expression. (Faber & Faber, n.d.)

In summary, technology represents an innovative approach to creativity in music for children, with certain interactive and creative experiences that are less likely to be provided in traditional approaches.

2.5 Establishing of Rhythmic Concepts in Beginning Piano Students

Rhythmic response is very natural for all human beings, and it is central to musical experience and understanding. Sehon and O'Brien (1951) mentioned that, rhythm sense is natural in every child. Educators role is to help these children to develop and cultivate their natural rhythmic capabilities. Spohn (1977) defined rhythm as regular occurring units of time or pulses, and fixed pulses or units of time are referred as a beat. He also explained that a quaver note equals to the basic pulse, which serves as a reference point to construct rhythmic patterns through augmentation of diminishing the notational value of this basic beat.

Reifinger (2006) mentioned that rhythmic abilities can be learned and developed through maturation, acculturation, and active learning. Rhythmic understanding and knowledge usually are developed in relation to maturation. The ability to identify, reproduce and creating rhythmic patterns in young children increases as they grow up (McPherson, 2006; Shedan, 1987). Acculturation, in other word, is musical understanding through exposure and repetition (McPherson, 2006; Phillips, 2013; Putkinen, Saarikivi & Tervaniemi, 2013). Active learning approach involves auditory, kinaesthetic, and visual models in order to understand rhythmic concepts in a holistic manner (Dunn, 2008).

There were masses of teaching practices designed to develop rhythm skills in children. Radocy & Boyle (1979) summarized that development of rhythm skills can be divided into six teaching approaches: conducting, tapping or clapping the rhythm phrase, eurhythmics (the expression of musical concepts through body movements), counting aloud, use of rhythm syllables or words, and rote performance. Numerous research studies have been carried out on children on the mentioned rhythm teaching practices under controlled conditions and have yielded positive results in aid to rhythmic performance accuracy (Dalcroze, 1967; Boyle, 1970; Palmer, 1976; Bebeau, 1982).

To cultivate rhythmic concepts in beginning piano students, one needs to understand that the beat is the foundation of rhythmic understanding for musicians. The beat is also an important concept that must be taught and reinforced in the early years of a student's music learning (Drake & Gerard, 1989; Miller, 2012; Schewinger, 2015). However, the beat can be intangible to young children if they are not exposed to a beat sample or model. Miller (2012) discussed a few ways to reinforce the beat in children through auditory, kinaesthetic and visual methodologies.

Another school of thought believes that auditory method as discussed by Miller (2012) plays a vital role in building rhythmic sense in children. Aural perception before teaching notation, or in other term, rote-before note method has been given much attention in music educational research (Gordon, 1977; Stockton, 1982; Shehan, 1987). Dalby (2005) identified that teaching rhythm by notational practice creates more confusion. He also mentioned that teaching rhythm through mathematical analysis of rhythmic relationships, which is a customary practice among music teachers, is ineffective. This is because rhythm audiation and mathematical analysis involve two significantly different cognitive processes. Repeated aural training prior to sight read has been proved effective in rhythm teaching. Extensive aural training would train the student to hear the music through recall when the sound itself is not physically present, which creates a model for notation reading. This experience is called audiation.

Memory-aid rhythm teaching technique, also known as mnemonics, is another method commonly used in music education. Orff and Kodály uses rhythm syllables in early childhood music education. Rhythmic patterns through word syllables will encourage children to remember the rhythmic grouping of the shared initial consonant (Dickel, 1983). Kintsch (1970) also mentioned that rehearsing vocalizations are easier than imagery, word syllables recited aloud would eventually aid rhythm patterns memorization. However, many piano teachers enforced counting system in teaching beginning students. This system requires the students to have a basic knowledge on time signature, bars and placing certain numbers in context to the overall bar. Schwinger

(2013) mentioned that this system may be too advanced for young children. It should be reserved for use only with secondary-aged students, as more concrete understanding of time signatures and their function is needed.

Bebeau (1982) mentioned that when training young children on rhythmic patterns, it should be noted that children at young age could generally process music with one beat of sound equals to one quaver note. Any rhythmic patterns beyond that music meter is considered difficult for children at seven or eight years old to process. Gardner (1971) carried out a research study on children's duplication of rhythmic patterns. He suggested that music teachers must have knowledge regarding age-appropriate music notation in teaching young children.

In the past, researchers have investigated the effect of using metronome as a strategy to improve beat synchronization (Coffman, 1988; Hanberry, 2004; Whittaker, 1997). Hanberry (2004) examined on 39 group piano students, which he divided into two groups: practise with the metronome and practise without the metronome. He found that the group of students who practiced with metronome has better beat consistency and general accuracy than those practiced without metronome.

Drum tracks, which is commonly available on all electronic keyboards, are useful in establishing rhythmic concepts in beginning piano students. Drum track is an excellent tool to help children in understanding the concept of a beat, and concepts of beats in a bar and beats-per-minute (tempo). Similar to metronome, drum tracks are a useful tool for better beat consistency in children performance. Together with the auto-accompaniment ability, idea of counting and keeping in time during performance will be inculcated in children (Marsden, 2013a). Selecting appropriate style according to the pieces they learn will introduce children to various rhythmic patterns and musical genre too.

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Gordon & Martin (1994) observed that students who were learning to play electronic keyboard with drum tracks often have difficulties in keeping in time with the drum tracks. They pointed out that the abilities to play consistently in time, to play a rhythm against the background beat coming from the drum tracks, and to play on the correct beat through a recognition of the first beat of the bar were all considered to be relevant skills. Therefore, an assessment was carried out to evaluate the mentioned skills on 38 students aged 12-14. The results showed that about 33.3% to 50% of students were unable to master these three skills on relatively simple tasks. Students performed worse when musically more sophisticated tasks were imposed.

Although many piano teachers still regard an electronic keyboard as an easy instrument to master, the above research showed that performing on electronic keyboard with drum tracks might not be as easy as we thought. When accompanying on a piano, accompanists usually will compensate the student's timing errors, whereas performing on an electronic keyboard with drum tracks would not. Lehmann & Kopiez (2009) mentioned that, performing under real-time conditions also encourages the student to expect how the music might continue, avoiding student to stop at every mistake and trying to correct it. This skill is only possible if the student has sufficient experience and knowledge in certain music style. Therefore, adopting drum tracks of different music styles on electronic keyboard for piano teaching may improve playing fluency of children in performing a piece.

2.6 Auditory Modelling, Audio-Visual Approach and Performance Accuracy

Aural modelling is an essential component of effective music teaching, which was introduced as one of the rhythm teaching methods reviewed in Section 2.5. Auditory instruction allows music teachers to communicate with children about rhythmic concepts without note reading (Phillips, 2013). Music learning through auditory modelling was reviewed to have a better insight in this research study.

Sequenced accompaniment that serves as backing track could be viewed as an aural model in teaching young children. Rote teaching or learning has played a significant role in some of the music teaching methods today, e.g. Suzuki method and Yamaha Music Education. Through rote learning, children are taught to imitate what they hear and see. Rote-to-note procedure, in the other hand, has been adopted by many piano teachers in their teaching, where students were encouraged to grasp its aural image before note reading starting to learn a piece. MIDI sequenced recordings can be viewed as a form of auditory model, therefore quantitative research studies related to auditory modelling were reviewed to gain insight on the role of sequenced accompaniment in piano teaching.

Fincher (1983) studied the effects of playing the melody by rote during the prestudy procedure upon sight reading skill development of beginning class piano students. She divided her study subjects (second year college students of non-keyboard majors) into two main groups, one group played a melody by rote in a prestudy procedure and another group with an analytical prestudy procedure. The group played by rote improved significantly with less score of pitch and rhythmic errors. This may suggest that playing along with a sequenced accompaniment, which serves as auditory model, could be valuable in improving rhythmic accuracy in performance.

Frewen (2010) carried out an experiment on children aged five to ten to determine the effect of aural familiarity with a melody on children's note accuracy when learning to play a simple keyboard melody. A total of 97 children with no previous formal instrumental instruction was divided into the experiment group and the control group. Only the experiment group was introduced to a model of the melody repeatedly before the assessment. A two-factor ANOVA was performed to study the effect of grade (kindergarten, 1, 2, 3, 4) and familiarity (familiar or unfamiliar melody). The results of this study showed that children played significantly more correct notes when they were familiar with the melody played compared to the group that were not introduced with the melody before assessment. The performance accuracy also increased in linear trend with grade level. The conclusion implies that aural modelling equips children with a greater error recognition capability which later enhance their ability to self-correct and motivate them to persevere in learning to play an instrument.

Persellin (1992) carried out a research to study children responses to rhythm patterns presented through auditory, visual, and kinaesthetic modalities. A total of 210 First-grade, third-grade and fifth-grade children were tested by presenting to them icons (visually), resonator bell (auditorily), by patting the child's hand (kinaesthetically) and a combination of all treatments. From the result, multimodality presentation did not confuse the children's rhythm learning ability. There was a significant difference among grades. The first graders visual test results were significantly lower than older graders. This indicated visual modal alone was not effective in teaching rhythmic patterns to young children. A combination of various modalities should be applied in rhythm trainings of young children.

Shedan (1987) recruited 25 second-grade and 24 sixth-grade students in the suburban Midwest to study rhythm learning and retention through rote and visual teaching. Four conditions were tested: audio-rhythm using woodblock, audio-mnemonics using mnemonics syllables, audio-visual rhythm with notation displayed, and audio-visual-mnemonics with combined notation and vocalization of the pattern. The result from this quantitative study indicated that for beginning students, mixed visual and aural methods was the most effective method in learning rhythm patterns. Auditory and visual

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channels used concurrently would enhance the learning retention of rhythms among young children with little formal music training.

From the above literatures, although aural training plays a vital role in developing auditory and musical sensitivity, audio-visual approach which combines aural modelling and notational symbols is more effective in developing music reading skills and rhythm learning. Shehan (1987) suggested that beginning students might learn rhythmic patterns more effectively when they are presented with rhythmic concepts both aurally and visually. Therefore, auditory modelling (sequenced accompaniment) with visual aid (music notation) would be applied in this research.

2.7 Assessment and Quantification of Rhythmic Performance

To evaluate the effectiveness of a teaching method, a valid assessment is needed to trace the progress of students in rhythm learning.

Generally, perception in music is measured by asking a student to demonstrate the ability to do a task. One of the main goals in judging a music performance is through pitch and rhythm accuracy (Peters, 1993). For performance-based assessment, teachers usually will assess students on musical skills that are easy, difficult, familiar, or unfamiliar (MENC [NAfME], 1996).

To assess rhythmic abilities, students are usually asked to reproduce a piece or a pattern through actions such as clapping or stepping, singing or playing on an instrument. Video or audio recordings are obtained during the assessment, and are used for later review. Quasi-experiment of pretest-posttest becomes common in recent studies on assessing performance accuracy and continuity. Numbers of quasi-experiment research on performance accuracy and fluency will be discussed in Section 2.8.

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The most common method of scoring rhythmic performance is to decide whether the performance is accurate or inaccurate while listening to the subject's performance (Gordon, 1977; Ibbotson & Morton, 1981). Performances are compared to the judges' mental model of a given rhythm pattern.

A more advance scoring method includes translating auditory performances into visual signal outputs (Farnsworth & Poynter, 1931; Heinlein, 1929; Jersild & Bienstock, 1935; Osburn, 1981; Stetson & Tuthill, 1923; Thackray, 1972). Comparing to the first method where performance was scored instantly, precision of visual records is higher, and it is a pathway to computer automations. However, people seldom perform with mathematical accuracy, and the visual method should be adjudicated when it comes to time consumption and scoring complexity.

MIDI technology has changed the way research in music performance practice is carried out. MIDI protocol allows performer's exact performance gestures to be recorded and translated into coded data which provides information such as time the key was pressed, pitch, velocity, and after-touch for further musicological and computational analyses (Dorfman, 2016). The *PianoBar*, which is developed by Bob Moog and Buchla Labs, enables an ordinary acoustic piano to send MIDI information to a sequencer, provides option in collecting performance data from acoustic instrument for quantification and assessment.

One of the problems faced by music researchers is the consistency and accuracy of scoring rhythmic performance. Usually, rhythmic performance responses are scored as being either correct or incorrect, however, rhythmic measurement and scoring is more complex especially when dealing with children (Grieshaber, 1994). Young children often imitating rhythm patterns at a tempo different than originally started.

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Scoring criteria also contributes as another source of complication in rhythm performance scoring. Nearly all performances would be scored as inaccurate if standard of scoring is too strict. On the other hand, if standards are too lax, all subjects would get high scores (Grieshaber, 1994). Therefore, before administering an assessment, the researcher or teacher must define what is to be expected as an outcome to ensure judging success (MENC [NAfME], 1996).

Schwinger (2015) carried out a study to find out how performance condition affects rhythmic accuracy while sight-reading on second-grade children. She applied a convenience sampling method, with 62 second-grade students as participant of the experiment. Rhythmic accuracy was judged dichotomously as either correct or incorrect. Incorrect rhythmic performances were further divided into rhythmic errors and tempo errors. However, test materials used in this experiment was ten separate rhythmic patterns instead of a complete piece of music. She also suggested that a more resonant instrument such as a triangle or a recorder to replace the drum in future study of the same topic, and wider age range of students could be explored.

2.8 Past Research on Effects of MIDI/ Sequenced Accompaniment towards Piano Rhythmic Performance Accuracy and Playing Fluency

Before MIDI technology was popular, researcher often studied on the effect of tape-recordings towards performance quality. The experimental treatment required the participants to have the same skill as playing with a sequenced accompaniment although MIDI technology was not adopted. Watkins (1984) investigated the ability of sight-read singing and instrumental accompaniments by using a tape-recorded soloist on college group piano students. From her study, it was discovered that accompanists practiced with a recorded soloist performed with significantly higher rhythmic accuracy than accompanists practiced without a recorded soloist.

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A study on effects of interval prestudy and MIDI accompaniments as an indication for rhythmic continuity on sight-reading achievement of 20 group piano students was carried out by Beeler (1995). Fifty students in four classes were assigned to four treatment groups: sight-reading with sequenced accompaniment, sight-reading with interval prestudy, sight-reading with a combination of interval prestudy and sequenced accompaniment, and sight-reading without any guided instruction or sequenced accompaniment (control). Sight-reading achievement was determined by pitch accuracy, rhythmic accuracy, total accuracy, and beat errors (a measurement for rhythmic continuity). The result showed that, participants who sight-read with the sequenced accompaniment performed significantly better with increased rhythmic accuracy and rhythmic continuity. Participants who played using structured interval prestudy exercises without sequenced accompaniment improved in pitch accuracy, but not on rhythmic accuracy. The researcher also advised that it is important to emphasize rhythmic continuity in sight reading activities.

Davis (2001), on the other hand, measured piano performance quality through dynamic accuracy. Although the experiment measurement was not directly focused on rhythm, the experimental design and treatment intervention procedures were reviewed since it was related to piano performance quality with the aid of MIDI accompaniment in general. In the questionnaire section, however, there was a discussion on MIDI accompaniments towards rhythmic continuity. Students (N = 39) were divided into three treatment groups: first group practiced without any MIDI accompaniment, the second group with MIDI accompaniment with narrow dynamic range, and the third group with a MIDI accompaniment with a wide dynamic range. The researcher found that students who practiced with MIDI accompaniment with wide dynamic range significantly performed better in term of dynamics accuracy on the posttest than on the pretest. In the questionnaire, participants responded that MIDI accompaniments aided in

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improving their playing fluency and dynamic expression. Positive attitudes of participants towards MIDI accompaniments was positively correlated to their adjusted gain scores of the experiment.

Ajero (2007) carried out study to investigate the effects of computer-assisted keyboard technology and MIDI accompaniments on group piano students' performance accuracy and attitudes. Subjects (N = 29) from piano classes of non-keyboard music major college students were divided into two groups, first group practiced with MIDI accompaniment and the other with guide mode on Yamaha Clavinova keyboards and MIDI accompaniment, which is considered to be computer-assisted keyboard instruction. Quasi-experimental pretest-posttest design was implemented to test the hypotheses, with two weeks treatment intervention. Posttest scores and pretest scores within subjects, and between treatment groups, were compared for significant differences in performance accuracy. From this study, Ajero (2007) mentioned that Guide Mode has improved pitch accuracy in piano student's initial stages of learning new repertoire when four outliers that skewed the data were removed. The researcher also recommended that MIDI accompaniments may assist in developing fluence playing after the students were comfortable with the pitches of a piece. However, it should be noted that the sample size of this study was very small, with significantly unbalanced Guide Mode group (n = *19*) and the MIDI-only group (n = *10*).

Besides focusing on sequenced accompaniments, there was also a research study carried out to compare MIDI accompaniments with other types of media. Benson (2002) compared effects of using MIDI sequenced recording, videotape, multimedia computer presentations and a control condition without instructional media on group piano student performance and attitude. There was no significant difference among several types of instructional media mentioned above on improving performance accuracy, including the control group. However, low sample size ($N = 29$) that was divided into four groups might be the reason null hypothesis was accepted in this research, bypassing true effect. On the other hand, in the questionnaire section, the group that had the MIDI recording intervention mentioned that MIDI sequenced recording was the condition that helped them the most in their practice.

2.9 Summary

Digital technologies have had an enormous impact in music education. Most of the past research reviewed have proven that sequenced accompaniments are effective in rhythm trainings, improving performance accuracy and playing fluency (Ajero, 2007; Beeler, 1995; Davis, 2001 & Watkins, 1984). Such music technology in music education also has a motivational impact among young children (Brittin, 2000 & Brittin, 2001).

Note that targeted subjects tested in most of the past research on the effect of MIDI accompaniments on piano performance were limited to college students. The results should not be generalised and recommendations should not be assumed effective with young children. Small sample size of the tested subjects of past studies also reduced chance of detecting true effects, which might have affected the validity and reliability of their results.

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CHAPTER 3: METHODOLOGY

This study was designed to examine the main effect of electronic keyboard styles on rhythmic accuracy and playing fluency of children aged six to eight in two conditions: with sequenced accompaniments, or without sequenced accompaniments. The methodology of this study was designed and modified based on Ajero (2007) and Schwinger (2015).

This research was designed with reference to Ajero (2007), where participants recruited were divided into an experimental group and a control group, and rhythmic accuracy (which was one of the performance accuracy variables) was tested through quasi-experimental pretest-posttest design. However, number of subjects were increased to a total of 60 participants in this experiment; children aged six to eight were recruited instead of university students. Procedures of the experiment and assessment measurement were modified based on Schwinger (2015). In this experiment, two complete piano pieces were used instead of ten rhythmic patterns to allow both rhythmic accuracy and playing fluency to be tested. The metronome was replaced by sequenced accompaniments. Electronic keyboard as a more resonant instrument replaced the drum used in Schwinger's research.

3.1 Participants

Sixty students ($N = 60$) aged six to eight with less than one-year private piano lesson under thirteen piano teachers of two music centres were recruited for this study. All students participated in weekly, 60-minute individual piano lessons. Piano lessons consisted of practical session and music theory. Students recruited consist of 27% of male, and 73% of female. Students were purposely recruited based on age ratio of 1:1:1, with 20 students in each age group. Each of the participants within the age group were

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then randomly assigned to one of two groups: The Control group (*n* = 30) and the Accompaniment group (*n* = 30).

3.2 Selection of Piano Composition and Teaching Materials

The researcher composed two 4-bar length piano compositions that is within the performance ability of students in their beginning stage of piano learning. This is to ensure that none of the participants would have prior knowledge of pieces selected to ensure data collected was accurate. The compositions involved semibreve, minim, crotchet, quaver, as well as syncopated rhythm.

Six exercises were designed based on rhythmic patterns of two compositions mentioned above for teaching purposes. Each of the piece was printed in a landscape orientation A4 sized card and was placed on the electronic keyboard's music stand at the student's eye level. The printed pieces were decorated with colourful illustrations to maintain students' interest in reviewing the piece.

Each note value (semibreve, minim, crotchet, quavers) with illustrations were also prepared in A5 sized card for introducing and revising note values during each instructional session with each participant.

Two sequenced accompaniments with contrasting styles (March and Swing) were developed using Yamaha Workstation PSR-S750. These two styles were selected in considering their rhythmic nature. March has a strong regular rhythm which focuses on down beats whereas Swing is chosen to assist in illustrating syncopated or upbeat rhythms. Midi files were transported to digital audio workstation (DAW), Cubasis 2.0 application on iPad through iCloud for further editing. Accompaniments consisted of percussions, harmony with pre-recorded styles provided by the workstation, and counter melody or fill ins added by the researcher. Final projects were then mixed down to a stereo audio file to be played back during pretest and posttest. Two bars counting "One, two, three, four; one, two, ready, go" were also recorded using microphone into an audio file at 80 bpm in order to give participants a steady beat introduction.

3.3 Variables

For this study, the independent variable was with or without sequenced accompaniments. The dependent variable was pretest and posttest scores of rhythmic accuracy and fluency errors at the beginning and at the end of the testing procedure. Test scores in pretest to posttest performances of the sequenced accompaniment group was compared to test scores performances of the group without sequenced accompaniment that practiced the same composition.

For participants practicing with sequenced accompaniments, independent variable was with or without backing track; dependent variable was pretest and posttest scores of rhythmic accuracy at the beginning and at the end of the testing procedure. Test scores in pretest to posttest performances with the backing track was compared to test scores of performances without backing track of the same composition.

For participants practicing with sequenced accompaniments, another variable was also tested. Independent variable was with or without exchange of musical style; dependent variable was the pretest and posttest scores of rhythmic accuracy at the beginning and at the end of the testing procedure. Test scores in pretest to posttest performances with the original musical style (e.g., March style) was compared to test scores performances with style exchanged (e.g., Swing style) of the same composition.

3.4 Experimental Procedure Test

Prior to the experiments, a trial session was carried out with a 6-year-old piano beginner student, who was the youngest for this age group and was not among the

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participants recruited, to determine the most suitable tempo to be used among young children to play the compositions for this study. The student was requested to play the two composed melodies with tempi of 80 bpm, 90 bpm and 100 bpm.

The assessment carried out found that 80 bmp was the most comfortable tempo to play quavers (smallest note value of the rudiments selected) for children of the youngest age of this research. This was supported by past research findings, suggested that 80 bpm was an acceptable tempo for the processing speed of young musicians (Persellin, 1992; Shehan, 1987). The student was also able to follow the researcher's instructions and perform all the tasks accordingly. It was presumed that if the youngest student could perform in the trial, other older students recruited would be able to accomplish the task too.

3.5 Procedures

The experiment was conducted following Randomised Control-Group Pretest-Posttest design. Participants were randomly assigned to the Accompaniment group (with sequenced accompaniments) and the Control group (without sequenced accompaniment) within each age group.

A meeting with the researcher was arranged with each participant before the experiment. The meet and greet session included explanation about the purposes of the research. Children were told they would be asked to participate to determine how best to help beginning piano students to play well in the future.

Pretest was administered to both the treatment group and the control group. Participants were introduced with the note values illustrated on the A5 cards prepared, and which keys to be pressed on the keyboard. Each participant was told to explore and be comfortable with the touch of the keys on the keyboard, and was then given 30 seconds to study the piece before assessment begins. Participants was guided with two bars steady beat with counts (one-two-three-four; one-two, ready, go) at 80 crotchet beats per minute (bpm). Audio and midi data were recorded.

During the first instructional session, researcher revised note values illustrated on A5 card with each child. In the Accompaniment group, each participant was taught to play Rhythm Pattern Exercise A1 with the sequenced accompaniment developed earlier after the participant has mastered the note value reading. Each of the participant in the Control group in the other hand was taught to play Rhythm Pattern Exercise B1 using a conventional rhythm counting method commonly used in piano teaching. The interval between each instructional period was one week. A session of 30 minutes was allocated for each instructional session.

In the second instructional session, children in two different groups revised Rhythm Pattern Exercise A2 and B2, respectively, with the Accompaniment group with sequenced accompaniments and the Control group with conventional rhythm counting method.

In the third instructional session, children in two different groups revised Rhythm Pattern Exercise A3 and B3, respectively, with the Accompaniment group with sequenced accompaniments and the Control group with conventional rhythm counting method.

In the fourth meeting, each participant revised all Rhythm Pattern Exercises previously taught with the same condition prior to posttest, with the Accompaniment group with sequenced accompaniments and the Control group with conventional rhythm counting method.

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During the posttest assessment, each participant was again told to explore and be comfortable with the touch of the keys on the keyboard, and was then given 30 seconds to study the piece before assessment begins. Participants were guided with two bars steady beat with counts (one-two-three-four; one-two, ready, go) at 80 crotchet beats per minute (bpm). Each participant in the Accompaniment group was also asked to contribute twofold: to play the piece once in a solo condition (without backing track) and to play the piece with backing track.

To analyse if the exchange of backing track with different music style affects rhythmic accuracy test scores of participants practicing with sequenced accompaniments, participants practicing in the Accompaniment group was asked to play Piece A with Swing style backing track, and Piece B with March style backing track.

3.6 Data Collection and Data Scoring

In the experiments, midi data of pretest and posttest was recorded using Cubasis 2.0 application on iPad. iPad was connected to Yamaha workstation PSR-S750's USB port via lightning to USB Camera Adapter. Each of the test data was assigned to a track labelled with recording number for reference. Videos were also recorded for each participant for reference.

Rhythmic accuracy and fluency errors were judged aurally in each bar by the researcher from MIDI data recorded on Cubasis 2.0, with reference to the video recordings of each participants. Data scoring rules for rhythmic accuracy and fluency errors were listed based on overall data collected, and the rules were used as guidelines to score the data to ensure consistency and precision of results.

Rhythmic accuracy was judged dichotomously as correct or incorrect for each note of the bars. To be correct, each note was correctly proportioned to each other in relation

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to the pulse. For each correctly performed note, the participant received one point (1). No point was awarded for note that was performed incorrectly. A maximum of twelve points and a minimum of zero point was possible for each test.

Playing fluency was evaluated by fluency errors in each test. An error in fluency was assigned to beats in which there was a disruption to the pulse in one of the following ways:

- Pauses or hesitations between notes within or between beats in a measure – errors assigned to the beat in which the error was made (within) or to the beat that did not occur in time (between)
- Pauses or hesitations between measures – errors assigned to the first beat of the second measure
- Repetition of notes in a measure (going back and replaying a note, not adding notes) – errors assigned to the beat immediately following where the break to repeat occurred
- Radical/abrupt change in tempo – errors assigned to the beat in which it happened

For each error, the participant received a penalty of one error point (1).

Rhythmic accuracy test scores and fluency error scores were then analysed using IBM® SPSS® (Statistical Package for the Social Sciences) Statistics version 24.

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CHAPTER 4: RESULTS

Main purposes of this study were: (1) to compare rhythmic accuracy and playing fluency test score of participants aged six to eight practicing with sequenced accompaniments and with the use of conventional rhythm counting method; (2) to identify if Swing style sequenced accompaniment may help young children in learning difficult rhythm patterns such as syncopation; and (3) to identify the effect of different performance conditions (with or without backing track; Swing or March style sequenced accompaniments) to the rhythmic accuracy of participants.

Participants were beginning piano students aged six to eight, with less than one-year private music instruction. Sixty-two children were recruited from 13 piano teachers of two music centres in Kuching, Sarawak. Participants were grouped by their age, and randomly assigned to one of the two different treatment groups within their age groups. Each student in the Control group (n = 31) and the Accompaniment group (n = 31) had a weekly 30-minute private lesson in their respective music centres with the researcher. All students worked on six Rhythm Pattern Exercises with one or two targeted rhythmic patterns in each exercise, rhythmic patterns gradually increased in difficulty throughout the lesson period. One student recruited in the Accompaniment group quit piano lesson during the second instructional session. Another student recruited in the Control group was discovered to be nine years old after the experiment and was removed from the data. Therefore, a total of 60 participants (n = 30 in each group) were involved in statistical analyses below. Table 4.1 shows the demographics information of participants in the Control and the Accompaniment groups.

Table 4.1 Participants' demographics information

Groups	Age	Number of Participants (N)	Percentage (%)
Control	6	20	33.33
	7	20	33.33
	8	20	33.33
	Total	60	100.00
Accompaniment	6	20	33.33
	7	20	33.33
	8	20	33.33
	Total	60	100.00

Participants were assigned into the Control group and the Accompaniment group as listed in Table 4.1. Participants in the Control group received Treatment 1 (attended four piano playing with conventional counting lessons) and participants in the Accompaniment group received Treatment 2 (attended four piano playing with sequenced accompaniments lessons). Each participant attended a total of two hours lessons, 30 minutes each lesson, one-week interval between each lesson. If a child could not attend the lesson on a particular day, an adjustment was made a day before or after the assigned date. All lessons and tests were conducted by the researcher. During each lesson, participant revised note value cards. Next, participants were introduced to two four-bar rhythm exercises, and trained according to their assigned treatment groups.

Participants' rhythmic accuracy test scores were scored from midi data recorded using Cubasis 2.0 on iPad. Test scores were then reconfirmed with recorded videos.

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Guidelines for data scoring were devised to standardise the scoring of data after participants responses were analysed from recorded videos of each participant.

Even though tempo of both pieces were set at 80 crotchet beats in a minute, not all children followed the given tempo during their playing. Therefore, rhythmic accuracy was scored based on each participant's first bar's tempo.

Each piece was divided into four blocks for data scoring, and the count value of every note in each block were measured (accurate or inaccurate).

Semibreve was considered inaccurate if it was held shorter than four counts; semibreve held longer than four counts were considered accurate. This is due to the nature that most children tend to hold the last note on the keyboard and turned their head to the researcher waiting for approval to release their fingers.

Two separate sets of test scores (pretest, posttest) were compared with two groups (Control, Accompaniment). Statistical analyses were conducted for two compositions: A Bus Driver (Piece A) and A Train (Piece B), at significance level (α = 0.05). A computer programme, IBM® SPSS (Statistical Package for the Social Sciences) Statistics® version 24 was used to calculate the results.

4.1 Rhythmic Accuracy and Playing Fluency Test Score between the Control Group and the Accompaniment Group

Research Question 1: How does rhythmic accuracy and playing fluency test scores of participants practicing with sequenced accompaniments compare to rhythmic accuracy and playing fluency test score of participants practicing with conventional rhythm counting method?

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4.1.1 Rhythmic Accuracy Test Score between the Control Group and the Accompaniment Group

Sub-Research Question 1.1: How does rhythmic accuracy test score of participants practicing with sequenced accompaniments (Accompaniment group) compare to rhythmic accuracy test score of participants practicing with conventional rhythm counting method (Control group)?

Collected data was checked for normality through SPSS, to determine the type of test to be used for analysis. Data skewness within the range of -2 to 2, and kurtosis within the range of -4 to 4 were considered to be normally distributed, then a parametric test that assumes dependent variable is normally distributed would be used.

Table 4.2 Analysis of normality for both pretest and posttest in total rhythmic accuracy test scores

Piece	Time	Skewness	Kurtosis
A	Pretest	- 0.440	0.697
	Posttest	-1.278	0.804
B	Pretest	- 0.119	0.453
	Posttest	- 0.629	- 0.482
A + B	Pretest	-0.318	0.236
	Posttest	-0.995	0.196

Table 4.2 shows that both pretest and posttest test scores were normally distributed in total rhythmic accuracy test scores for Piece A, Piece B and combined Piece A and B. Normal Quantile-quantile (Q-Q) plots were also used to confirm the distribution of the dependent variables (Figure 4.1). Therefore, a parametric test was chosen in analysing these data.

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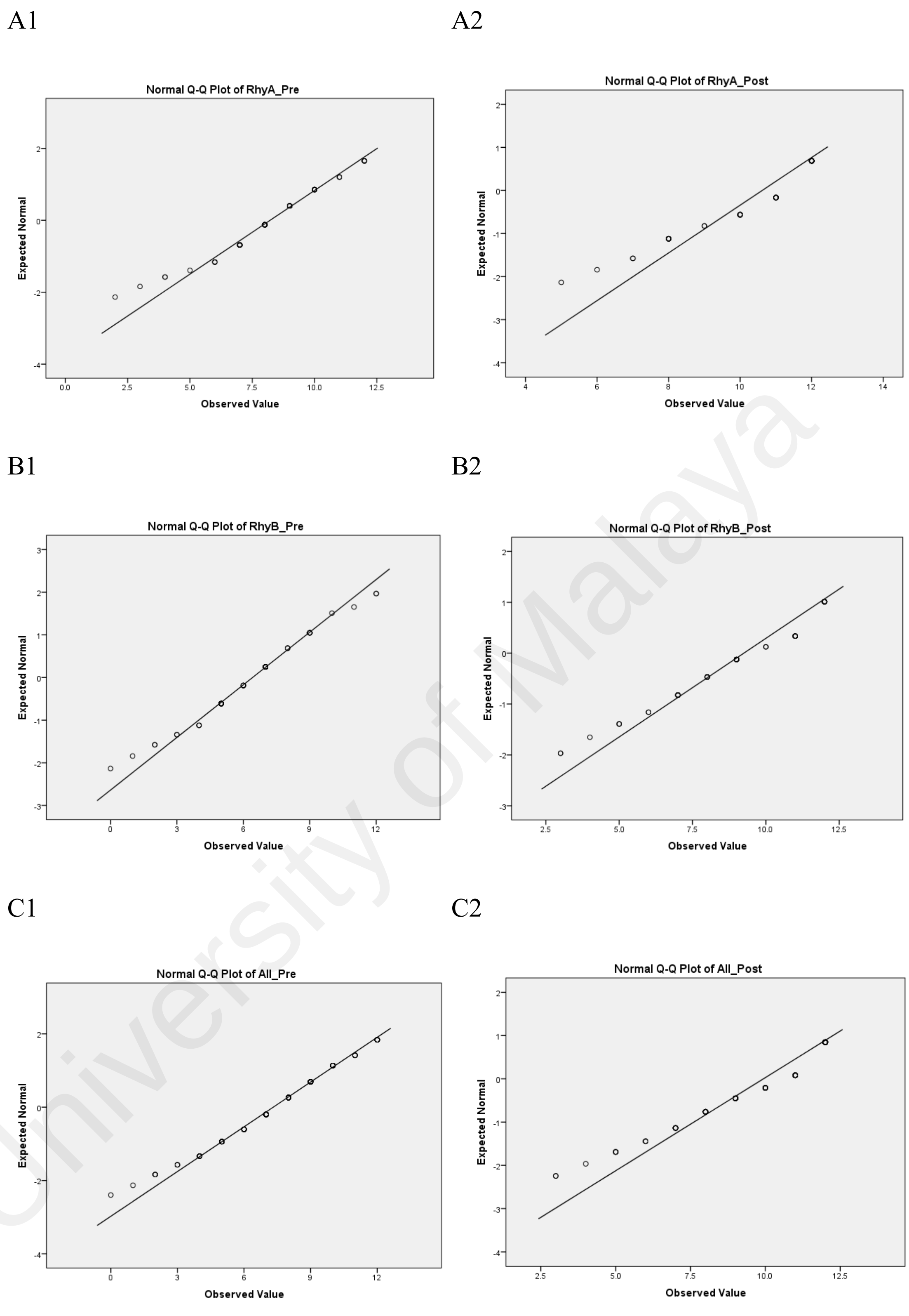

Figure 4.1: Normal Q-Q plots of pretest and posttest rhythmic accuracy test scores of Piece A and Piece B. (A1) Piece A Pretest, (A2) Piece A Posttest, (B1) Piece B Pretest, (B2) Piece B Posttest, (C1) Piece A+B Pretest, (C2) Piece A+B Posttest.

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The experiment was designed where subjects were separated into two separate groups based on "between-subjects" factor (Control, Accompaniment), and "within-subjects" factor (Pretest, Posttest). Therefore, Mixed Analysis of Variance (ANOVA) with pretest and posttest scores were conducted for the two compositions: A Bus Driver (Piece A) and A Train (Piece B), at significance level ($\alpha = 0.05$).

4.1.1.1 Rhythmic Accuracy Test Scores of the Control Group and the Accompaniment Group of Piece A

The mean, standard deviation and standard error mean for the time (Pretest, Posttest) and treatment groups (Control, Accompaniment) rhythmic accuracy test scores for Piece A are shown in Table 4.3.

Table 4.3: Descriptive statistics of treatment groups and time of Piece A.

Group	Time	Mean	N	Std. Deviation	Std. Error Mean
Control	Pretest	7.900	30	2.090	0.382
	Posttest	9.633	30	1.938	0.354
Accompaniment	Pretest	8.533	30	2.193	0.400
	Posttest	11.600	30	0.932	0.170

A 2 (Pretest, Posttest) x 2 (Control, Accompaniment) repeated measures ANOVA was conducted on Piece A rhythmic accuracy. There was a significant main effect for rhythmic accuracy within subjects (Pretest, Posttest), $F(1, 58) = 120.946$, $p < 0.001$, $\eta^2 = 0.676$; a significant main effect for rhythmic accuracy between the Accompaniment group and the Control group, $F(1, 58) = 9.263$, $p = 0.004$, $\eta^2 = 0.138$; and a significant interaction between time (pretest, posttest) and treatment groups (Accompaniment, Control), $F(1, 58) = 9.332$, $p = 0.003$, $\eta^2 = 0.139$.

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Pairwise comparison was conducted on rhythmic accuracy test scores in pretest and posttest on Piece A.

Table 4.4: Pairwise comparison on rhythmic accuracy test scores of Piece A between time (pretest, posttest) and groups (control, accompaniment).

Group	(I) Test	(J) Test	Mean Difference (I-J)	SE	P value[b]	η^2
Control	Posttest	Pretest	1.733*	0.309	<0.001	0.352
Accompaniment	Posttest	Pretest	3.067*	0.309	<0.001	0.630

* The mean difference is significant at the .05 level., b Adjustment for multiple comparisons: Bonferroni.

Results as shown in Table 4.4 indicated that posttest rhythmic accuracy test score (M=11.60, SD=0.932) was significantly different compared to pretest rhythmic accuracy test score (M=7.90, SD=2.090) for the Control group; $p < 0.001$, $\eta^2 = 0.352$. Posttest test score (M=9.63, SD=1.938) for the Accompaniment group was also significantly different compared to pretest rhythmic accuracy test score (M=8.53, SD=2.193); $p < 0.001$, $\eta^2 = 0.630$.

Figure 4.2 shows the mean rhythmic accuracy test scores for the Control group and the Accompaniment group of Piece A.

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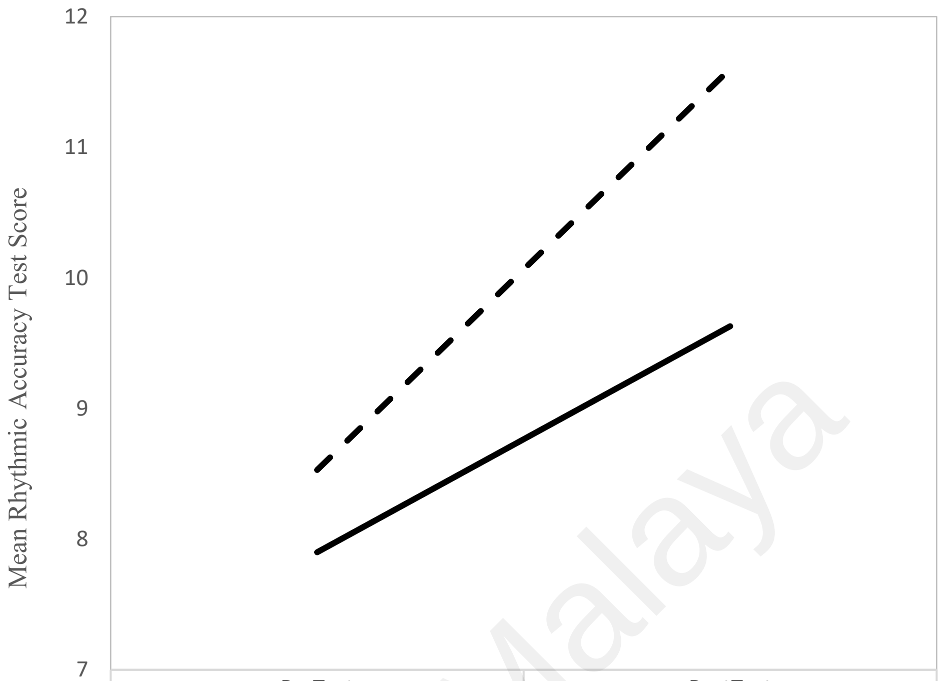
Piece A Mean Rhythmic Accuracy Test Scores



	PreTest	PostTest
Control	7.90	9.63
Accompaniment	8.53	11.60

Figure 4.2: Mean rhythmic accuracy test scores of the Control group and the Accompaniment group of Piece A.

From Figure 4.2, both the Accompaniment and the Control groups showed increment in rhythmic accuracy test score over time (pretest, posttest). However, mean rhythmic accuracy test scores of the Accompaniment group was generally higher than mean rhythmic accuracy test scores of the Control group. The differences between pretest and posttest scores of the Accompaniment group (35.99%) was larger than the Control group (21.90%).

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4.1.1.2 Rhythmic Accuracy Test Scores of the Control Group and the Accompaniment Group of Piece B

The mean, standard deviation and standard error mean for the time (Pretest, Posttest) and treatment groups (Control, Accompaniment) rhythmic accuracy test scores for Piece B are shown in Table 4.5.

Table 4.5: Descriptive statistics of treatment groups and time of Piece B.

Group	Time	Mean	N	Std. Deviation	Std. Error Mean
Control	Pretest	6.000	30	2.000	0.365
	Posttest	7.900	30	2.310	0.422
Accompaniment	Pretest	6.833	30	2.768	0.505
	Posttest	10.600	30	2.111	0.385

A 2 (Pretest, Posttest) x 2 (Control, Accompaniment) repeated measures ANOVA was conducted on *Piece B* rhythmic accuracy. There was a main effect for rhythmic accuracy within subjects (Pretest, Posttest), $F(1, 58) = 111.717$, $p < 0.001$, $\eta^2 = 0.658$; a significant difference between the Accompaniment group and the Control group, $F(1, 58) = 10.926$, $p = 0.002$, $\eta^2 = 0.159$; and a significant interaction between time (pretest, posttest) and treatment groups (Accompaniment, Control), $F(1, 58) = 12.123$, $p = 0.001$, $\eta^2 = 0.173$.

Pairwise comparison was conducted on rhythmic accuracy test scores in pretest and posttest on Piece B.

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Table 4.6: Pairwise comparison on rhythmic accuracy test scores of Piece B between time (pretest, posttest) and groups (control, accompaniment).

Group	(I) Test	(J) Test	Mean Difference (I-J)	SE	P value[b]	η^2
Control	Posttest	Pretest	1.900*	0.379	<0.001	0.302
Accompaniment	Posttest	Pretest	3.767*	0.378	<0.001	0.630

* The mean difference is significant at the .05 level., b Adjustment for multiple comparisons: Bonferroni.

Results as shown in Table 4.6 indicated that posttest rhythmic accuracy test score (M=7.90, SD=2.310) was significantly different compared to pretest rhythmic accuracy test score (M=6.00, SD=2.000) for the Control group; $p < 0.001$, $\eta^2 = 0.302$. Posttest test score (M=10.60, SD=2.111) for the Accompaniment group was also significantly differenct compared to pretest rhythmic accuracy test score (M=6.833, SD=2.768); $p < 0.001$, $\eta^2 = 0.630$.

Figure 4.3 shows the mean rhythmic accuracy test scores for the Control group and the Accompaniment group of Piece B.

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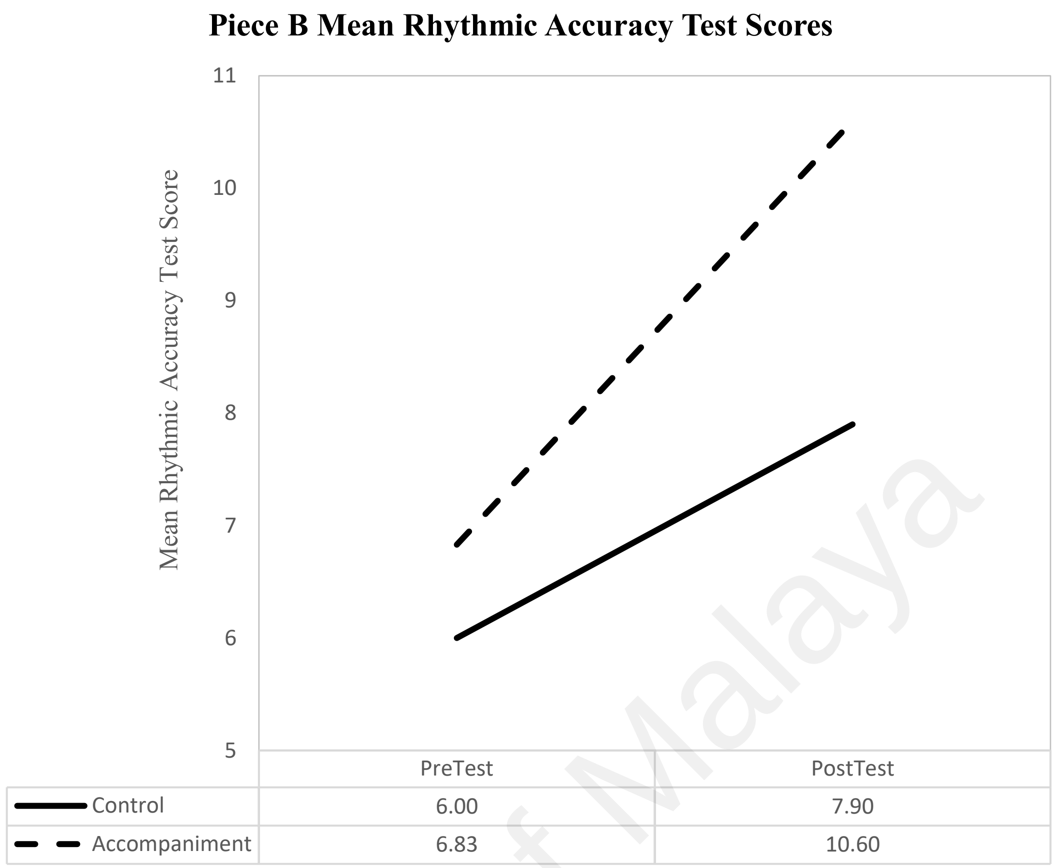

Figure 4.3: Mean rhythmic accuracy test scores of the Control group and the Accompaniment group of Piece B.

From Figure 4.3, both the Accompaniment and the Control groups showed increment in rhythmic accuracy test scores over time (pretest, posttest). However, mean rhythmic accuracy test score of the Accompaniment group was generally higher than mean rhythmic accuracy test score of the Control group as in Piece A. The differences between pretest and posttest scores of the Accompaniment group (55.20%) was larger than Control group (31.67%), and the mean differences of different groups of Piece B is greater than Piece A.

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4.1.1.3 Combined Rhythmic Accuracy Test Scores of the Control Group and the Accompaniment Group

To analyse the overall effectiveness of treatments on the Control and the Accompaniment groups despite the piece, rhythmic accuracy test scores of Piece A and Piece B were combined.

The mean, standard deviation and standard error mean for the time (Pretest, Posttest) and treatment groups (Control, Accompaniment) rhythmic accuracy test scores of a combination of Piece A and Piece B are shown in Table 4.7.

Table 4.7: Descriptive statistics of treatment groups and time for combined data of Piece A and B.

Group	Time	Mean	N	Std. Deviation	Std. Error Mean
Control	Pretest	6.950	60	2.243	0.290
	Posttest	8.767	60	2.288	0.295
Accompaniment	Pretest	7.683	60	2.620	0.338
	Posttest	11.100	60	1.694	0.219

When rhythmic accuracy test scores were combined for both Piece A and Piece B, there was a main effect for rhythmic accuracy within subjects (Pretest, Posttest), $F(1, 118) = 228.896$, $p < 0.001$, $\eta^2 = 0.660$; a significant difference between the Accompaniment group and the Control group, $F(1, 118) = 17.193$, $p < 0.001$, $\eta^2 = 0.127$; and a significant interaction between time (pretest, posttest) and treatment groups (Accompaniment, Control), $F(1, 118) = 38.400$, $p < 0.001$, $\eta^2 = 0.153$.

Pairwise comparison was conducted on combined rhythmic accuracy test scores in pretest and posttest on Piece A and B.

Table 4.8: Pairwise comparison on rhythmic accuracy test scores of combined Piece A and B between time (pretest, posttest) and groups (control, accompaniment).

Group	(I) Test	(J) Test	Mean Difference (I-J)	SE	P value[b]	η^2
Control	Posttest	Pretest	1.817*	0.245	<0.001	0.319
Accompaniment	Posttest	Pretest	3.417*	0.245	<0.001	0.623

* The mean difference is significant at the .05 level., b Adjustment for multiple comparisons: Bonferroni.

Results as shown in Table 4.8 indicated that posttest rhythmic accuracy test score (M=8.77, SD=2.288) was significantly different compared to pretest rhythmic accuracy test score (M=6.95, SD=2.243) for the Control group; $p < 0.001$, $\eta^2 = 0.319$. Posttest test score (M=11.10, SD=1.694) for the Accompaniment group was also significantly different compared to pretest rhythmic accuracy test score (M=7.683, SD=2.620); $p < 0.001$, $\eta^2 = 0.319$.

Figure 4.4 shows the combined mean rhythmic accuracy test scores for the Control group and the Accompaniment group of Piece A and B.

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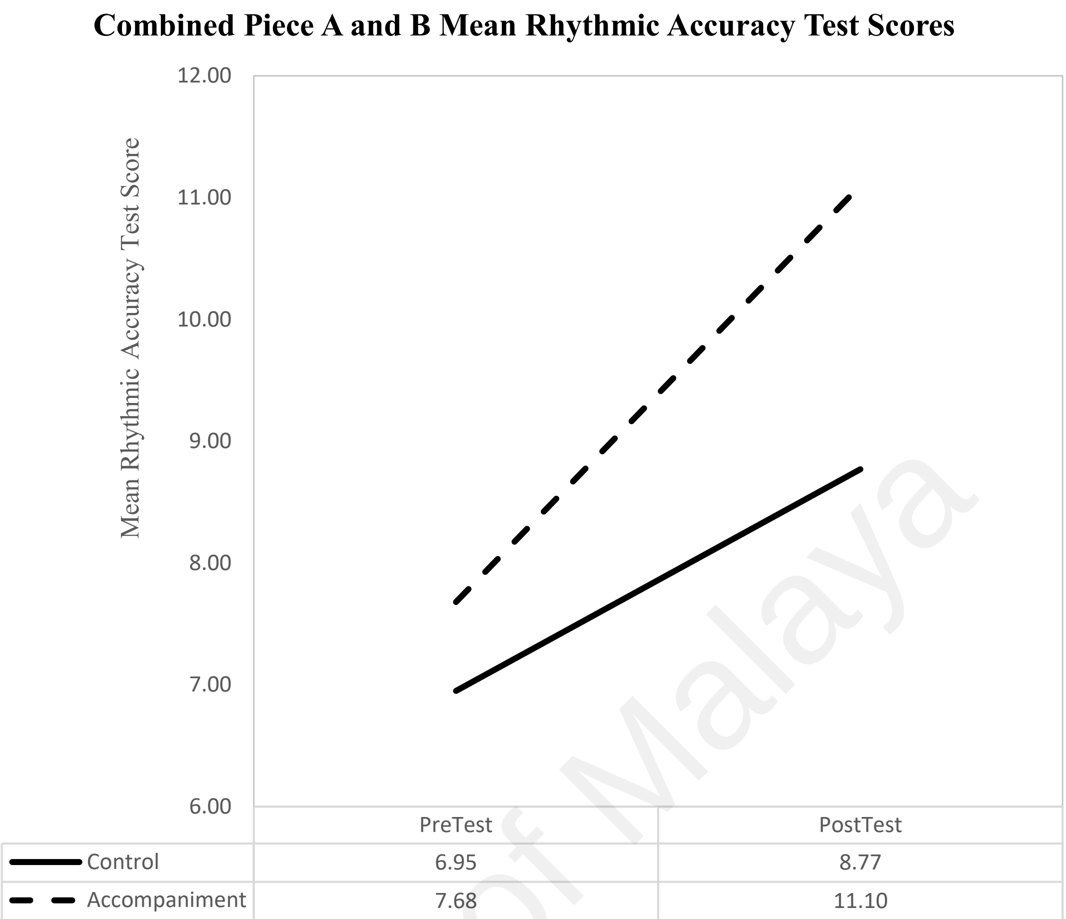

	PreTest	PostTest
Control	6.95	8.77
Accompaniment	7.68	11.10

Figure 4.4: Combined mean rhythmic accuracy test scores for the Control group and the Accompaniment group of Piece A and B.

From Figure 4.4, both the Accompaniment and the Control groups showed increment in rhythmic accuracy test scores over time (pretest, posttest). Mean rhythmic accuracy test scores of the Accompaniment group was generally higher than mean rhythmic accuracy test scores of the Control group. The differences between pretest and posttest scores of the Accompaniment group (44.53%) was larger than Control group (26.19%).

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4.1.2 Playing Fluency between the Accompaniment Group and the Control Group

Sub-Research Question 1.2: How does fluency errors of participants practicing with sequenced accompaniments (Accompaniment group) compare to fluency errors of participants practicing with conventional rhythm counting method (Control group)?

Although assumption of homogeneity of variances was violated from the data collected on fluency errors, with slightly skewed or kurtotic distributions, ANOVA is still considered robust to the assumption of normality, especially in this case where the sample size is large (N > 30 or 40) (Elliott & Woodward, 2007; Field, 2009). Therefore, Two-way repeated measures Analysis of Variance (ANOVA) with fluency error pretest and posttest scores were conducted for the two compositions, at significance level (α = 0.05).

4.1.2.1 Fluency Error Test Scores of the Control Group and the Accompaniment Group of Piece A

The mean, standard deviation and standard error mean for the time (Pretest, Posttest) and treatment groups (Control, Accompaniment) fluency error test scores for Piece A are shown in Table 4.9.

Table 4.9: Descriptive statistics of treatment groups and time of Piece A

Group	Time	Mean	N	Std. Deviation	Std. Error Mean
Control	Pretest	1.033	30	0.964	0.176
	Posttest	0.567	30	0.971	0.178
Accompaniment	Pretest	0.967	30	1.608	0.294
	Posttest	0.200	30	0.551	0.101

A 2 (Pretest, Posttest) x 2 (Control, Accompaniment) repeated measures ANOVA was conducted on Piece A fluency errors. There was a significant main effect for fluency errors within subjects (Pretest, Posttest), $F(1, 58) = 11.940$, $p = 0.001$, $\eta^2 = 0.171$. No significant main effect was found for fluency errors between the Accompaniment group and the Control group, $F(1, 58) = 0.988$, $p = 0.324$, $\eta^2 = 0.017$; and no significant interaction between time (pretest, posttest) and treatment groups (Accompaniment, Control), $F(1, 58) = 0.706$, $p = 0.404$, $\eta^2 = 0.012$.

Pairwise comparison was conducted on rhythmic accuracy test scores in pretest and posttest on Piece A.

Table 4.10: Pairwise comparison on fluency errors of Piece A between time (pretest, posttest) and groups (control, accompaniment).

Group	(I) Test	(J) Test	Mean Difference (I-J)	SE	P value[b]	η^2
Control	Pretest	Posttest	0.467	0.252	0.070	0.056
Accompaniment	Pretest	Posttest	0.767*	0.252	0.004	0.137

* The mean difference is significant at the .05 level., b Adjustment for multiple comparisons: Bonferroni.

Results as shown in Table 4.10 indicated that there was no significant effect between posttest fluency errors (M=0.567, SD=0.971) and pretest fluency errors (M=1.033, SD=0.964) for the Control group; $p = 0.070$, $\eta^2 = 0.056$. Posttest fluency errors (M=0.200, SD=0.551) for the Accompaniment group was significantly different compared to pretest fluency errors (M=0.967, SD=1.608); $p = 0.004$, $\eta^2 = 0.137$.

Figure 4.5 shows the mean fluency errors for the Control group and the Accompaniment group of Piece A.

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Estimated Marginal Means Fluency Error of Piece A

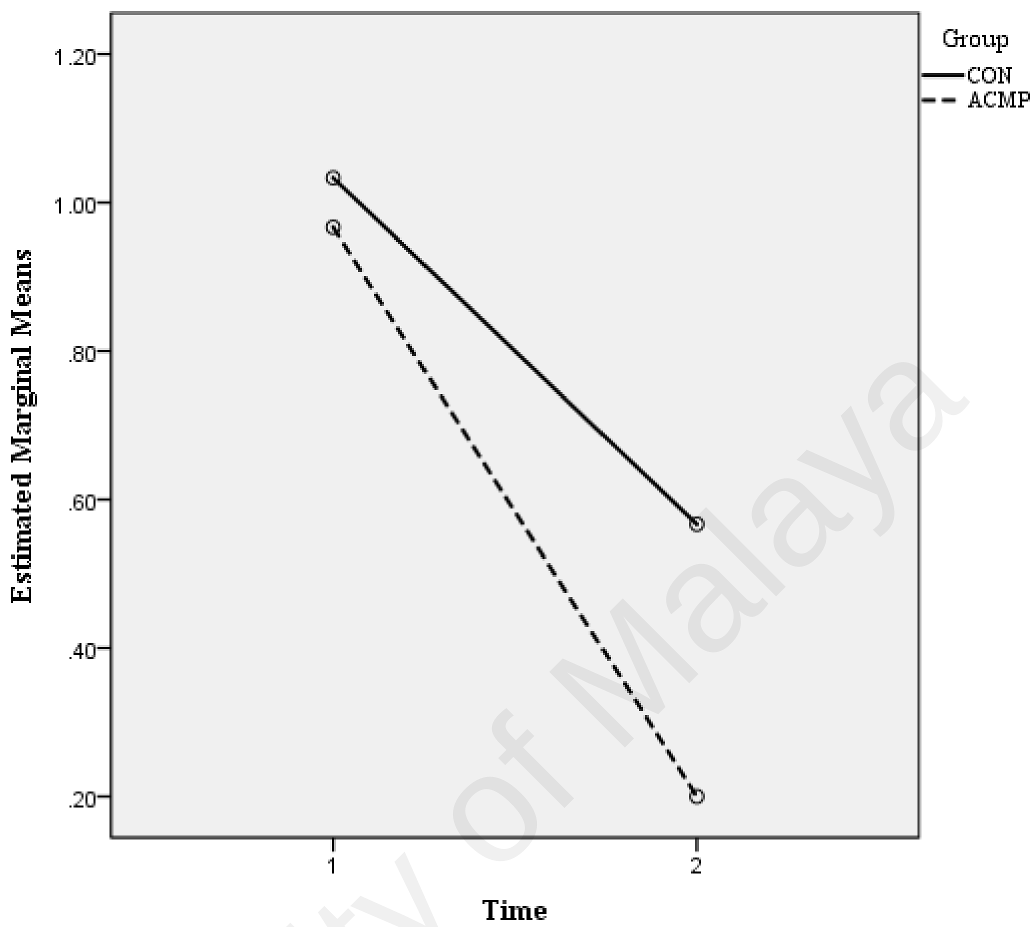

Figure 4.5: Mean fluency errors of the Control group and the Accompaniment group of Piece A.

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4.1.2.2 Fluency Error Test Scores of the Control Group and the Accompaniment Group of Piece B

The mean and variance for the time (Pretest, Posttest) and treatment groups (Control, Accompaniment) fluency error test scores for Piece B are shown in Table 4.11.

Table 4.11: Descriptive statistics of treatment groups and time of Piece B

Group	Time	Mean	N	Std. Deviation	Std. Error Mean
Control	Pretest	1.467	30	1.776	0.324
	Posttest	0.533	30	0.571	0.104
Accompaniment	Pretest	1.633	30	1.629	0.297
	Posttest	0.167	30	0.379	0.069

A 2 (Pretest, Posttest) x 2 (Control, Accompaniment) repeated measures ANOVA was conducted on Piece B fluency errors. There was a significant main effect for fluency errors within subjects (Pretest, Posttest), $F(1, 58) = 35.966$, $p < 0.001$, $\eta^2 = 0.383$. No significant main effect was found for fluency errors between the the Accompaniment group and the Control group, $F(1, 58) = 0.155$, $p = 0.695$, $\eta^2 = 0.003$. There was a significant interaction between time (pretest, posttest) and treatment groups (Accompaniment, Control), $F(1, 58) = 1.776$, $p = 0.188$, $\eta^2 = 0.030$. Figure 4.10 shows the mean fluency errors for the Control group and the Accompaniment group of Piece B.

Pairwise comparison was conducted on rhythmic accuracy test scores in pretest and posttest on Piece B.

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Table 4.12: Pairwise comparison on fluency errors of Piece B between time (pretest, posttest) and groups (control, accompaniment).

Group	(I) Test	(J) Test	Mean Difference (I-J)	SE	P value[b]	η^2
Control	Pretest	Posttest	0.500*	0.235	0.038	0.072
Accompaniment	Pretest	Posttest	0.800*	0.235	0.001	0.166

* The mean difference is significant at the .05 level., b Adjustment for multiple comparisons: Bonferroni.

Results as shown in Table 4.12 indicated that posttest fluency errors (M=0.533, SD=0.571) was significantly different compared to pretest fluency errors (M=1.467, SD=1.776) for the Control group; p = 0.038, η^2 = 0.072. Posttest fluency errors (M=0.167, SD=0.379) for the Accompaniment group was also significantly different compared to pretest fluency errors (M=1.633, SD=1.629); p = 0.001, η^2 = 0.166.

Figure 4.6 shows the mean fluency errors for the Control group and the Accompaniment group of Piece B.

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Estimated Marginal Means Fluency Error of Piece B

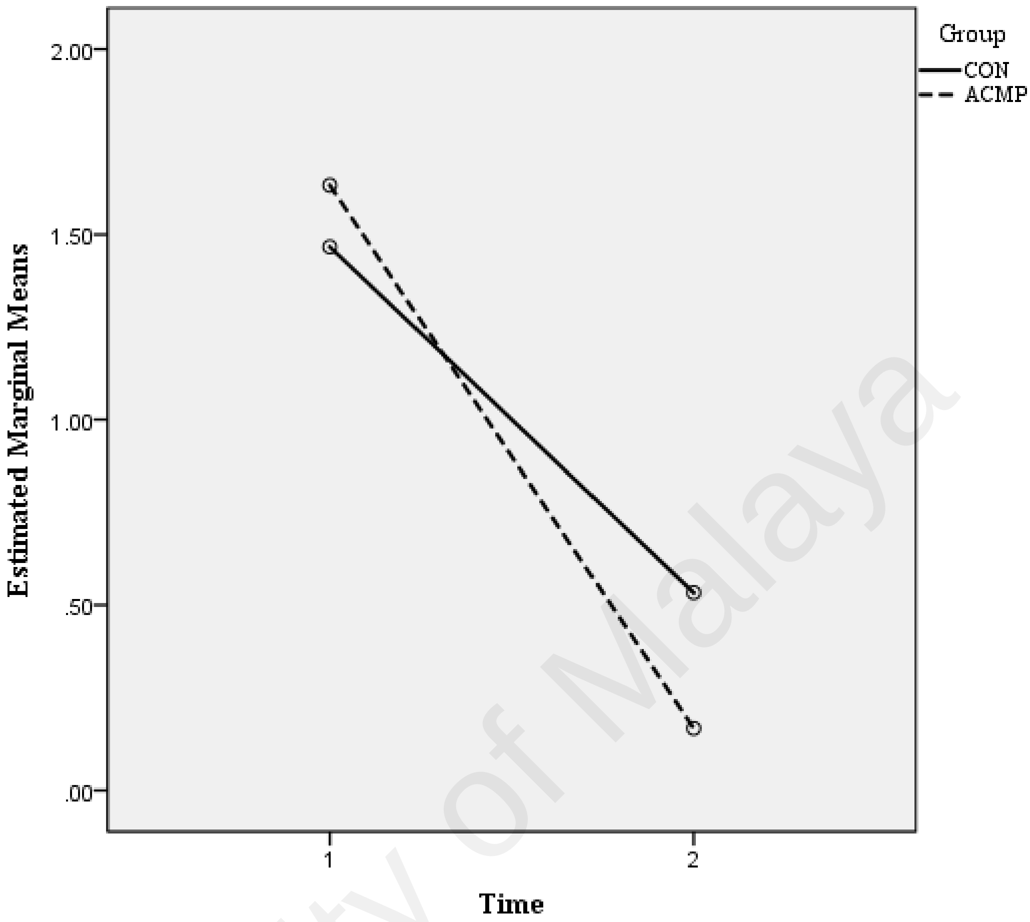

Figure 4.6: Mean fluency errors of the Control group and the Accompaniment group of Piece B.

4.1.3 Interaction between Practicing Treatment Groups and Age Groups

Sub-Research Question 1.3: Are the children's age groups affected rhythmic accuracy test scores of participants practicing with sequenced accompaniments (Accompaniment group) compare to rhythmic accuracy test score of participants practicing with conventional rhythm counting method (Control group)?

Two-way Analysis of Covariance (ANCOVA) with posttest rhythmic accuracy test scores as dependent variable and pretest rhythmic accuracy test scores as covariate were

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carried out for Piece A and Piece B, at significance level ($\alpha = 0.05$). The main effect within age groups, between treatment groups and interaction between treatment groups and age groups were determined statistically.

4.1.3.1 Interaction between Practicing Treatment Groups and Age Groups of Piece A

The mean and standard deviation for treatment groups (Control, Accompaniment) and age groups (6, 7 and 8) rhythmic accuracy test scores of Piece A are shown in Table 4.13.

Table 4.13: Mean rhythmic accuracy posttest scores and standard deviations for different age groups of Piece A

Group	Age	Mean	Std. Deviation	N
Control	6	8.1000	2.07900	10
	7	9.8000	1.13529	10
	8	11.0000	1.33333	10
	Total	9.6333	1.93842	30
Accompaniment	6	11.5000	.97183	10
	7	11.3000	1.25167	10
	8	12.0000	.00000	10
	Total	11.6000	.93218	30

Two-way ANCOVA (Analysis of Covariance) was carried out to determine the effect, within age groups, and between treatments and age groups, with posttest rhythmic accuracy test scores as dependent variable and pretest rhythmic accuracy test scores as covariate. The analysis showed a significant main effect for treatment groups, $F(1, 53) = 34.497$, $p < 0.001$, $\eta^2 = 0.394$. However, there was no significant main effect for age groups, $F(2, 53) = 0.797$, $p = 0.456$, $\eta^2 = 0.029$. Significant interaction between treatment groups and age groups was observed from the analysis result, $F(2, 53) = 6.898$, $p = 0.007$, $\eta^2 = 0.171$.

Pairwise comparison was conducted on rhythmic accuracy test scores in pretest and posttest on Piece A.

Table 4.14: Pairwise comparison on rhythmic accuracy test scores of Piece A between age groups (6, 7, 8) and groups (Control, Accompaniment).

Age Group	(I) Group	(J) Group	Mean Difference (I-J)	SE	P value[b]	η^2
6	Accompaniment	Control	3.072*	0.509	<0.001	0.407
7	Accompaniment	Control	1.281*	0.506	0.014	0.108
8	Accompaniment	Control	0.854	0.504	0.096	0.051

* The mean difference is significant at the .05 level., b Adjustment for multiple comparisons: Bonferroni.

Group	(I) Age Group	(J) Age Group	Mean Difference (I-J)	SE	P value[b]
Control	7	6	1.081	0.524	0.133
	8	6	1.661*	0.584	0.019
	8	7	0.581	0.524	0.820
Accompaniment	6	7	0.710	0.517	0.527
	6	8	0.557	0.563	0.981
	8	7	0.153	0.520	1.000

* The mean difference is significant at the .05 level., b Adjustment for multiple comparisons: Bonferroni.

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Table 4.14 shows that there is a significant difference between treatment groups of participants aged six, $p < 0.001$, $\eta^2 = 0.407$; and participants aged seven, $p < 0.014$, $\eta^2 = 0.108$. However, for participants aged eight, there was no significant effect between treatment groups, $p < 0.019$.

For the Control group, significant effect was only shown between the age group of six and eight, $p < 0.019$, $\eta^2 = 0.051$. No significant difference between age groups was observed under the Accompaniment group.

Figure 4.7 shows the mean rhythmic accuracy posttest scores of participants from ages 6, 7 and 8.

Covariates appearing in the model are evaluated at the following values: Rhythmic accuracy pretest score = 8.2167.

Figure 4.7: Estimated marginal mean rhythmic accuracy posttest scores of participants from ages 6, 7 and 8 of Piece A

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From Figure 4.7, estimated marginal mean rhythmic accuracy posttest scores of different age groups, with pretest score as covariate, depended on treatment intervened. The estimated marginal mean rhythmic test scores for the Accompaniment group across ages were constant whereas for the Control group, estimated marginal mean increased by age.

4.1.3.2 Interaction between Practicing Treatment Groups and Age Groups of Piece B

The mean and standard deviation for treatment groups (Control, Accompaniment) and age groups (6, 7 and 8) rhythmic accuracy test scores of Piece B are shown in Table 4.15.

Table 4.15: Mean rhythmic accuracy posttest scores and standard deviations for different age groups of Piece B

Group	Age	Mean	Std. Deviation	N
Control	6	6.600	2.633	10
	7	7.800	1.814	10
	8	9.000	1.703	10
	Total	7.900	2.310	30
Accompaniment	6	10.200	1.751	10
	7	10.100	2.885	10
	8	11.500	1.269	10
	Total	10.600	2.111	30

Two-way ANCOVA (Analysis of Covariance) was carried out to determine the effect, within the groups, and between treatments and age groups, with posttest rhythmic accuracy test scores as dependent variable and pretest rhythmic accuracy test scores as covariate. The analysis showed a significant main effect for treatment groups,

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$F(1, 53) = 76.258$, $p < 0.001$, $\eta^2 = 0.312$. However, there was no significant main effect for age groups, $F(2, 53) = 1.178$, $p = 0.316$, $\eta^2 = 0.043$. No significant interaction between treatment groups and age groups was observed from the analysis result, $F(2, 53) = 0.888$, $p = 0.418$, $\eta^2 = 0.032$.

Pairwise comparison was conducted on rhythmic accuracy test scores in pretest and posttest on Piece B.

Table 4.16: Pairwise comparison on rhythmic accuracy test scores of Piece B between age groups (6, 7, 8) and groups (Control, Accompaniment).

Age Group	(I) Group	(J) Group	Mean Difference (I-J)	SE	P value[b]	η^2
6	Accompaniment	Control	3.164*	0.803	<0.001	0.226
7	Accompaniment	Control	1.864*	0.803	0.024	0.092
8	Accompaniment	Control	1.861*	0.801	0.024	0.092

* The mean difference is significant at the .05 level., b Adjustment for multiple comparisons: Bonferroni.

Group	(I) Age Group	(J) Age Group	Mean Difference (I-J)	SE	P value[a]
Control	7	6	1.006	0.799	0.640
	8	6	1.585	0.834	0.189
	8	7	0.579	0.822	1.000
Accompaniment	6	7	0.294	0.799	1.000
	8	6	0.282	0.828	1.000
	8	7	0.576	0.818	1.000

a. Adjustment for multiple comparisons: Bonferroni.

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Table 4.16 shows that there is a significant difference between the Control group and the Accompaniment group of all ages: 6-year-old, $p < 0.001$, $\eta^2 = 0.226$; 7-year-old, $p = 0.024$, $\eta^2 = 0.092$; and 8-year-old, $p = 0.024$, $\eta^2 = 0.092$. However, there were no significant difference between ages when all age groups were paired and compared.

Figure 4.8 shows the mean rhythmic accuracy test scores of participants from ages 6, 7 and 8, with pretest scores as covariates, evaluated at mean test scores = 6.4167.

Covariates appearing in the model are evaluated at the following values: Rhythmic accuracy pretest score = 6.4167.

Figure 4.8: Mean rhythmic accuracy posttest scores of participants from ages 6, 7 and 8 of Piece B.

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From Figure 4.8, estimated marginal mean rhythmic accuracy posttest scores of different age groups, with pretest score as covariate, also depended on treatment intervened. The estimated marginal mean rhythmic test scores for the Accompaniment group across ages were constant whereas for the Control group, estimated marginal mean increased by age, similar to Piece A.

4.2 Effect of Music Style in Learning Difficult Rhythm Pattern

Research Question 2: Will characteristics of a Swing style in sequenced accompaniment aid young children in learning syncopated rhythm pattern?

In order to analyse the effect of swing rhythm style of sequenced accompaniment in helping young children to learn syncopated rhythm, scored data of Bar 3-4 from Piece B were used in this statistical analysis. Table 4.17 shows the mean and standard deviation of pretest and posttest of the Control and the Accompaniment groups.

Table 4.17: Descriptive statistics of treatment groups and time of Bar 3-4, Piece B.

Time	Group	Mean	Std. Deviation	N
Pretest	Control	1.800	0.805	30
	Accompaniment	2.167	1.464	30
Posttest	Control	2.733	1.285	30
	Accompaniment	4.267	1.202	30

Collected data was checked for normality through SPSS, to determine the type of test to be used for analysis. Data skewness within the range of -2 to 2, and kurtosis within the range of -4 to 4 were normally distributed, then a parametric test that assumes dependent variable is normally distributed would be used.

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Table 4.18 Analysis of normality for both pretest and posttest in total rhythmic accuracy test scores

Time	Skewness	Kurtosis
Pretest	0.601	1.192
Posttest	-0.256	-1.492

Table 4.18 shows that both pretest and posttest test scores were normally distributed in total rhythmic accuracy test scores for Piece B. Therefore, a parametric test – repeated measures ANOVA was used in analysing these data.

To assess the effectiveness of different treatments, syncopated rhythm pattern of Piece B (Bar 3-4) were compiled for statistical analysis. A 2 (pretest, posttest) x 2 (Control, Accompaniment) repeated measures ANOVA conducted showed that there was a main effect for rhythmic accuracy within subjects (Pretest, Posttest), $F(1, 58) = 67.514$, $p < 0.001$, $\eta^2 = 0.538$. The result also showed that there was a significant difference between the Accompaniment group and the Control group, $F(1, 58) = 14.094$, $p < 0.001$, $\eta^2 = 0.195$. A significant interaction was observed between subjects (Pretest, Posttest) and treatment groups (Accompaniment, Control); $F(1,58) = 9.987$, $p = 0.003$, $\eta^2 = 0.147$.

Pairwise comparison was conducted on rhythmic accuracy test scores in pretest and posttest on Piece B.

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Table 4.19: Pairwise comparison on rhythmic accuracy test scores (Bar 3-4) of Piece B between time (pretest, posttest) and groups (Control, Accompaniment).

Group	(I) Test	(J) Test	Mean Difference (I-J)	SE	P value[b]	η^2
Control	Posttest	Pretest	0.933*	0.261	0.001	0.181
Accompaniment	Posttest	Pretest	2.100*	0.261	<0.001	0.527

* The mean difference is significant at the .05 level., b Adjustment for multiple comparisons: Bonferroni.

Results as shown in Table 4.19 indicated that posttest rhythmic accuracy test score (M=2.73, SD=1.285) was significantly different compared to pretest rhythmic accuracy test score (M=1.80, SD=0.805) for the Control group; $p = 0.001$, $\eta^2 = 0.181$. Posttest test score (M=4.27, SD=1.202) for the Accompaniment group was also significantly different compared to pretest rhythmic accuracy test score (M=2.17, SD=1.464); $p < 0.001$, $\eta^2 = 0.527$.

Figure 4.9 shows the mean rhythmic accuracy test scores of Bar 3-4 for the Control group and the Accompaniment group of Piece B.

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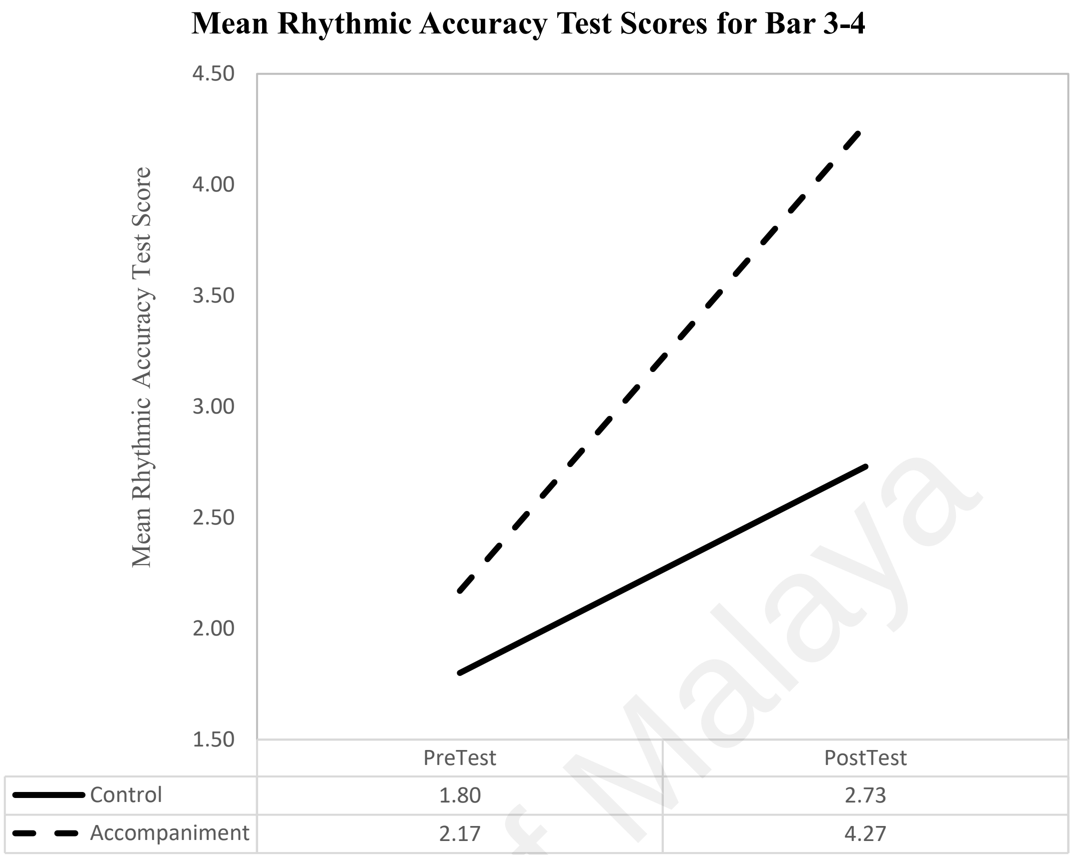

Figure 4.9: Mean rhythmic accuracy test scores of Bar 3-4 of the Control group and the Accompaniment group of Piece B.

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4.3 Effect of Performance Conditions to the Rhythmic Accuracy

Research Question 3: Will the performance conditions (with or without backing track; March and Swing style) during performance affect the rhythmic accuracy of participants practicing with sequenced accompaniments?

4.3.1 Effect of Backing Track during Performance to the Rhythmic Accuracy

Sub-Research Question 3.1: Will playing with or without backing tracks during performance affect the rhythmic accuracy of participants practicing with sequenced accompaniments?

To analyse the effect of performance conditions (with or without backing track), posttest rhythmic accuracy test scores of each piece from the Accompaniment group were analysed.

The mean, standard deviation, standard error mean and percentiles for performance conditions (Solo, Backing Track) rhythmic accuracy test scores of Piece A and B are shown in Table 4.20.

Table 4.20: Mean rhythmic accuracy test scores and standard deviations with different performance conditions of Piece A and Piece B.

Piece	Performance Condition	Mean	N	Std. Deviation	Std. Error Mean	Percentiles 25th	Percentiles 50th (Median)	Percentiles 75th
A	Solo	11.600	30	0.932	0.170	11.75	12.00	12.00
	Backing Track	11.133	30	1.943	0.355	10.75	12.00	12.00
B	Solo	10.600	30	2.111	0.385	9.00	11.00	12.00
	Backing Track	10.533	30	1.889	0.345	9.00	12.00	12.00

Collected data was checked for normality through SPSS, to determine the type of test to be used for analysis. Data skewness within the range of -2 to 2, and kurtosis within the range of -4 to 4 were considered to be normally distributed, then a parametric test that assumes dependent variable is normally distributed would be used. A non-parametric test would be chosen if the data were not normally distributed.

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Table 4.21: Analysis of normality for posttest of total rhythmic accuracy test scores

Piece	Performance Condition	Skewness	Kurtosis
A	Solo	- 2.912	8.735
	Backing Track	-3.072	10.678
B	Solo	- 1.599	2.164
	Backing Track	- 1.207	0.443

Table 4.21 shows that rhythmic accuracy test scores of Piece A and Piece B were not normally distributed. Therefore, a non-parametric test – Wilcoxon Signed-Rank Test instead of paired-sample *t*-test was used in analysing these data.

The analysis of Piece A showed that there was no significant difference between performance in solo and backing track conditions, Z = -1.895, p = 0.058. Indeed, median accuracy test scores for both conditions were 12.0, which was the maximum score that could be achieved by participants. There was also no significant effect between performance in solo and backing track conditions for Piece B, Z = -0.351, p = 0.726.

Figure 4.10 shows the total rhythmic accuracy test scores of participants performed with backing track and participants performed in a solo condition.

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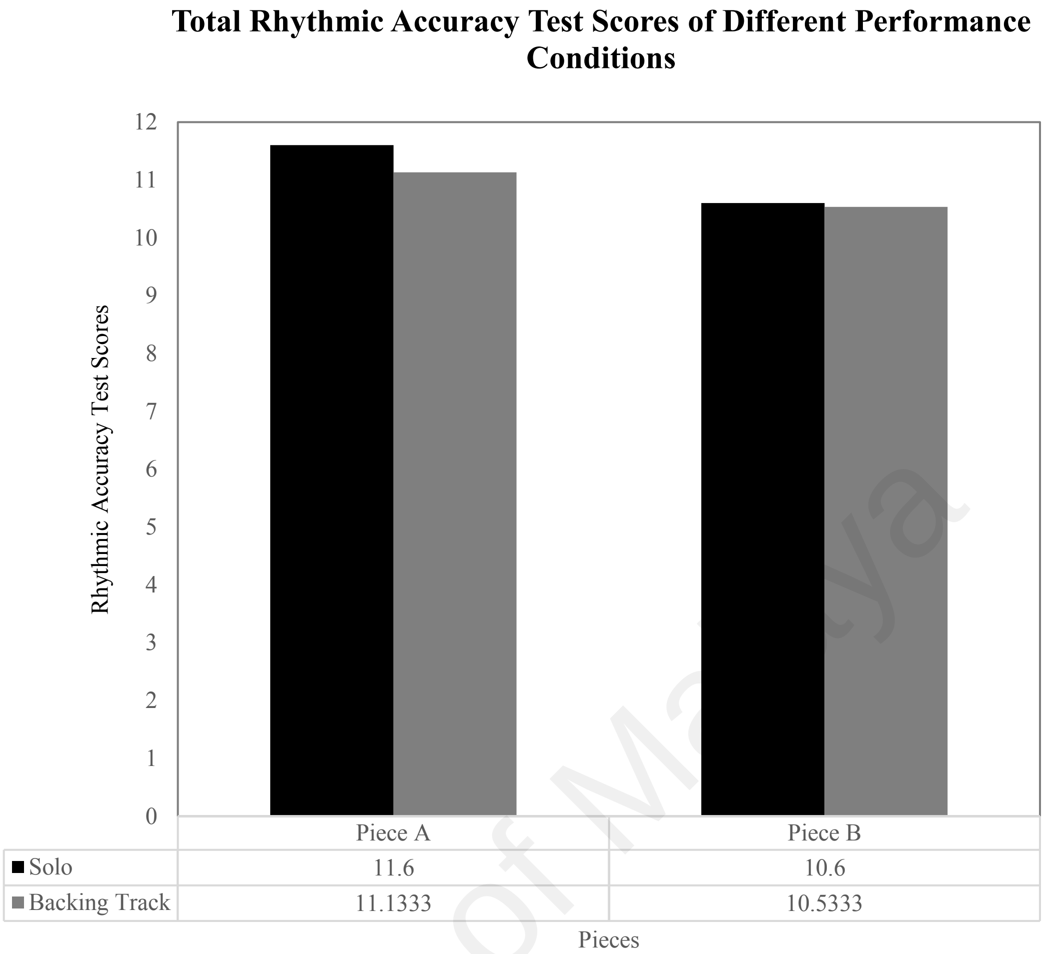

Figure 4.10: Mean rhythmic accuracy test scores of different performance conditions.

4.3.2 Backing Track Rhythmic Style Dependency on Learning Rhythmic Patterns

Sub-Research Question 3.2: Will exchange of backing track with different music style (March style and Swing style) affect rhythmic accuracy test scores of participants practicing with sequenced accompaniments?

To analyse the effect of exchanged backing track rhythmic styles (March, Swing) towards rhythmic accuracy test scores of each piece, posttest scores of the Accompaniment group were analysed.

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The mean, standard deviation, standard error mean and percentiles of rhythmic styles (March, Swing) rhythmic accuracy test scores of Piece A and B are shown in Table 4.22.

Table 4.22: Mean rhythmic accuracy test scores and standard deviations with different rhythmic styles of Piece A and Piece B.

Piece	Rhythmic Styles	Mean	N	Std. Deviation	Std. Error Mean	Percentiles		
						25th	50th (Median)	75th
A	March	11.133	30	1.943	0.355	10.75	12.00	12.00
	Swing	9.833	30	1.949	0.356	9.00	10.50	11.00
B	March	10.600	30	2.143	0.391	9.75	12.00	12.00
	Swing	10.533	30	1.889	0.345	9.00	11.00	12.00

Collected data was checked for normality through SPSS, to determine the type of test to be used for analysis. Data skewness within the range of -2 to 2, and kurtosis within the range of -4 to 4 were considered to be normally distributed, then a parametric test that assumes dependent variable is normally distributed would be used. A non-parametric test would be chosen if the data were not normally distributed.

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Table 4.23: Analysis of normality for posttest of total rhythmic accuracy test scores

Piece	Rhythmic Style	Skewness	Kurtosis
A	March	- 3.072	10.678
	Swing	-1.725	4.229
B	March	- 1.487	1.029
	Swing	- 1.207	0.443

Table 4.23 shows that rhythmic accuracy test scores of Piece A was not normally distributed. Therefore, a non-parametric test – Wilcoxon Signed-Rank Test was chosen for Piece A, and paired-sample *t*-test for Piece B in analysing these data.

A Wilcoxon signed-rank test showed that there is a significant difference between March style and Swing style of Piece A, $Z = -3.833$, $p < 0.001$. Median rhythmic accuracy test score for March style ($Mdn = 12.00$) is higher than Median rhythmic accuracy test score for Swing style ($Mdn = 10.50$).

A paired-sample *t*-test for rhythmic accuracy test scores of Piece B showed that no significant difference between March style and Swing style, $t(29) = 0.143$, $p = 0.888$ at 95% confidence level.

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CHAPTER 5: DISCUSSION AND CONCLUSION

This chapter provides test scores summaries and a discussion of results, conclusion of this research study and recommendation for future studies. The current study was undertaken partially to expand what is currently known about rhythm teaching systems and to aid in determining empirically based teaching method with the use of technology in piano lessons. Experimental data in this study supports and confirm discussion and recommendations among piano pedagogues' rhythm teaching system and the use of technology in music teaching and research.

Research Question 1: How does rhythmic accuracy and playing fluency test scores of participants practicing with sequenced accompaniments compare to rhythmic accuracy and playing fluency test scores of participants practicing with conventional rhythm counting method? There was a significant difference between the Accompaniment group and the Control group, $p < 0.001$ for both Piece A and Piece B and the combined test scores of both pieces for rhythmic accuracy test scores. The increment of rhythmic accuracy test scores from pretest to posttest of each piece were also significant at $p < 0.001$. The effect size of the Accompaniment group rhythmic accuracy test scores for Piece A and Piece B are almost doubled of the effect size of the Control group test scores. Results indicated that the teaching approach of the Accompaniment group is generally more effective than the conventional rhythm counting methods used in the Control group in piano teaching of children aged six to eight. No significant difference was found between pretest test scores of the Accompaniment and the Control group, confirming that these two groups of children were equally and fairly divided, which further justified the consistency and validity of results. Therefore, these quantitative results serve as a conclusive evidence that children practicing with sequenced accompaniments had a significant positive effect on overall rhythmic accuracy.

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The result of this study was similar to Beeler (1995). Beeler's finding also indicated that participants who sight-read with the sequenced accompaniment performed significantly better with increased rhythmic accuracy and rhythmic continuity. The difference between these two research studies were that this current study was focusing on two treatment groups whereas Beeler had four treatment groups for the experiment, which included sequenced accompaniment. Beeler's recruited university students for the experiment, which is contrasting to the age group recruited for this research study. Ajero (2007) also mentioned that MIDI-only treatment could be more effective in increasing performance accuracy after students are comfortable with the pitch of a piece. This relatively supported the result gained where children practicing with sequenced accompaniments improved significantly on rhythmic accuracy as pitch factor was eliminated when this experiment was designed.

To compare playing fluency of participants practicing with sequenced accompaniments with participants practicing with conventional rhythm counting method, fluency errors - where disruption to the pulse occurred during performance was used to determine the playing fluency of a piece. Generally, there was no significant effect between the Control group and the Accompaniment group for both Piece A and Piece B. Analyses within the groups revealed that a significant improvement in fluency errors on Piece A for the children who practiced with the sequenced accompaniment, but not a significant improvement for the children who practiced without it. For Piece B, even though analyses within the groups revealed that a significant improvement in fluency errors appeared on children who practice on with and without sequenced accompaniment, there was a greater improvement (more than half the value) from the Accompaniment group ($\eta^2 = 0.166$) compared to the Control group ($\eta^2 = 0.072$) when effect size were compared.

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Rhythmic accuracy test score of participants practicing with sequenced accompaniments (Accompaniment group) and rhythmic accuracy test score of participants practicing with conventional rhythm counting method (Control group) were also compared based on children's age groups. Pairwise comparison analyses showed that there was a significant difference between the Accompaniment group and the Control group for children of six years old and seven years old for Piece A; and in all age groups (6, 7 and 8 years old) for Piece B. When multiple comparisons were done between treatments and age groups, there was a significant difference between children of eight years old and children of six years old in the Control group, $p < 0.001$ of Piece A.

Generally, the effect of increasing age depends on the treatment intervened. For every treatment, increasing age produced increased rhythmic accuracy test score. For the Accompaniment group, however, increasing age before seven years old produced a slight decreased rhythmic accuracy test scores (Figure 4.7 and Figure 4.8 in Chapter 4). Thus, the consequences of increasing age depend on the treatment given. The results suggested that children practicing with sequenced accompaniments might be more effective in the earlier age (6 years old), however, test scores differences between age groups were very minimal (not statistically significant), which is not substantial to be highlighted. When test score results of the Accompaniment group were compared to the Control group, test score of the Accompaniment group was more consistent compared to the Control group, where the improvement of all ages was almost at the same level. This suggested that the sequenced accompaniment method is a universal approach for rhythm teaching for piano students across six to eight years old, whereas the conventional rhythm counting method is only suitable for the later age group (statistically significant between 6 years old and 8 years old in Piece A). Some previous research studies found that maturation plays a significant role in rhythmic responses of

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children (Rainbow & Owens, 1979; Klanderman, 1979; Gilbert, 1980; Schleuter & Schleuter, 1985). Even though motor skills are minimized during the research design of this study, cognitive skills which involve counting in the Control group might be a challenging task for younger age children. Schwinger (2013) mentioned that counting system which requires the students to have basic knowledge on time signature and bars could be too advanced for young children. She recommended that it should be reserved for use only with secondary-aged students.

Research Question 2: Will characteristics of a Swing style in sequenced accompaniment aid young children in learning syncopated rhythm pattern? Rhythmic accuracy test score for syncopated rhythm pattern increased significantly for children practicing with sequenced accompaniment with swing style. This suggested that swing music with drum tracks and instrumental accompaniment may increase the sense towards syncopated rhythm patterns. In another perspective, this might mean that music styles play an important role in cultivating various rhythmic sense in early piano learning. Sequenced accompaniment with appropriate musical style provides useful external rhythmic stimuli for students during their practice (Ajero, 2007).

Research Question 3: Will performance conditions (with or without backing track; March and Swing styles) during performance affect the rhythmic accuracy of participants practicing with sequenced accompaniments? No significant difference was found between performance in solo condition and performance with backing track condition of children taught with sequenced accompaniments during posttest. This finding suggested that sequenced accompaniments teaching method to improve rhythmic accuracy was effective with children aged six to eight regardless of performance conditions. Children could perform with high accuracy rhythmically even without backing track after they were taught to practice with sequenced accompaniments for four instructional sessions of 30 minutes each. Children might have developed rhythmic sense during their training with sequenced accompaniments with selected music styles. Big publishers such as Hal Leonard, Alfred Publishing and Faber Music are currently focusing on supplementing piano method books with MIDI backing tracks either in the form of a CD, online play-along tracks or even in the format of mobile applications with the same objectives to encourage the sense of beat and musical flow as well as to cultivate rhythmic continuity in students while practicing with such sequenced accompaniments. The finding here also explained the misconceptions where technology (in this case, sequenced accompaniments) would prevent musical qualities growth in children (William & Webster, 2006). The result proved that sequenced accompaniments, in fact, developed rhythmic sense in children after four practicing sessions, without over reliant on the backing track itself.

Children from the Accompaniment group were also tested if the exchange of backing track with March style and Swing style affect rhythmic accuracy test scores in Piece A and Piece B. Piece A that was originally composed to be practiced with March style sequenced accompaniment significantly decreased in rhythmic accuracy test score when backing track was changed to swing style. However, there were no difference between styles exchange in Piece B. The possibility of differences in test scores of Piece A might be caused by children's association of swing style to syncopated rhythmic patterns. Children tend to remember the rhythmic pattern they had learned in Piece B from hearing the backing track. Therefore, their memory towards the rhythmic pattern through hearing the music style surpassed their sight-read. Another possibility that explains the differences of test scores in Piece A is that a counter melody track enhancing the syncopation was included into the sequenced accompaniment of Swing style. Children instinctively followed the counter melody while performing. This

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supported the previous findings by Sang (1987) and Siebenaler (1997) which recommended that aural model benefits students in their performance.

In this research study, questionnaires on children preference towards practice conditions (with or without sequenced accompaniments) was not collected due to the range of age of participants which the data collected could be bias. However, the researcher observed that children who practiced with sequenced accompaniments enjoyed their lessons more than those who did not. They looked forward to the next session with the researcher.

Tempo stability among children practiced with or without sequenced accompaniments was also observed although not quantified. Children who practiced with sequenced accompaniments during their instructional sessions can maintain steady tempo during their performance without backing track compared to children practiced without sequenced accompaniment. Children practiced without sequenced accompaniment tended to increase in tempo when they performed after the two-bar introduction stopped. Kuhn and Gates (1975) carried out a similar research on maintaining steady pulse and found that students clapped the rhythmic patterns with increased tempo after the metronome which was set to 90 beats per minute was stopped. Mito and Murao (2001) investigated 16 young piano beginning children on tendency of tempo acceleration during performance. Children practiced the piece assigned for a week, and was tested on three different tempi (70, 100, and 130 beats per minute) with two bars tempo given prior to performance. It was observed that children increased their tempos when they perform with 70 and 100 beats per minute insentiently.

Music education and music industry have covertly growing with technological innovations (Gouzouasis & Bakan, 2011). Digital technologies have eventually moved into tablet computers and applications as well as networked digital tools. Besides

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adopting electronic keyboard music styles as a quicker and simpler way in creating sequenced accompaniments, this research study also used iPad application – Cubasis 2.0, which is more portable and flexible for data collection.

In conclusion, sequenced accompaniments has shown to be effective in increasing rhythmic accuracy and playing fluency of beginning piano children aged six to eight. Sequenced accompaniments as a teaching method has proven to be effective on children of all ages from six to eight, compared to conventional counting method which could only be applied on older children. Children practiced with sequenced accompaniments can perform with great rhythmic accuracy and tempo stability even without backing track during performance. Even though a piano teacher cannot be expected to rely upon sequenced accompaniments alone to improve rhythmic learning in beginning piano students, it is undoubtedly a valuable tool in teaching. The findings of this research study also proved that sequenced accompaniments are effective in music teaching, which fit the cognitive processes of music learning in young children, rather than merely providing fun experiences. These valuable findings will also contribute to the commercial opportunity and technology advancement of music education industry.

In the future study, it would be interesting to include mnemonics as another factor into rhythm teaching of young children along with sequenced accompaniments. "Pocket instrument technology" by Park (2016) should be explored either as a teaching tool or a research tool in future studies. Teaching with technology has infused into all aspects of our music educational system, subtlety and disruptively. Such disruptive technology is capable in transforming music research and education industries to a higher level in the near future. Music educators should embrace and engage educational technology and prepare our children for the future.

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