

A Piano Pedagogy for Late Beginners:
Taking Adolescent Beginners as an Example

Qing Yang

A Doctoral Dissertation

Submitted to the Elisabeth University of Music
in partial fulfilment of the requirements for
the degree of Doctor of Musical Arts

February 2022

審査委員

馬場 有里子



垣内 敦



壬生 千恵子



中谷 政文



岩永 誠



2022 (令和 4) 年 2 月 17 日

Acknowledgements

My deepest gratitude foremost to my two supervisors, Professor Dr. Chieko Mibu and Professor Miho Shibata, for their constant encouragement and guidance. Professor Chieko has walked me through all the stages of finishing this dissertation. She led me into the world of researchers and took me to participate in many academic presentations both here and abroad. Professor Miho has brought me to the ocean of music, learned a lot of the true meaning of music, and made me deeply understand the piano's spirit.

Special thanks should go to Professor Martin Hughes, who inspired me to explore the Western piano methods, and from him, I realised the pianist could sing by his soul. Also, I would like to thank my friend Benjamin Stringer, an American pianist, for helping with my English. I would like to also thank all the school faculty members for their help and support in the past four years.

Finally, I am sincerely grateful to my mother who has always supported and encouraged me. Thank you. Meanwhile, I must thank my other two teachers, Professor Dr. Wen Wang and Dr. Xiaoqin Yang in Sichuan Conservatory of Music, for their help in my music study.

Abstract

In contemporary China, in addition to the children and young adults pursuing musical education, many adolescents are also confronted with studying music because of China's growing social-education culture, which encourages them to get knowledge and skills related to the arts. Moreover, China's college entrance examination-supported score policy leads many adolescents seeking a spot in China's best comprehensive universities to try to take their examinations as art speciality students. Furthermore, art grade examination in China is more and more popular nowadays. It has become a kind of social phenomenon that many students seek to pass the examination and acquire a certificate to be more competitive in extracurricular classes. For the reasons above, the number of late piano beginners is increasing significantly, and they are seeking specialised education, exceptional instructors, and effective pedagogies. The background above is discussed in Chapter I.

The purpose of the research is to explore effective piano methodologies and scientific teaching strategies for adolescent beginners. Regarding this research's methods, several dimensions have been included. First, Chapter II reviews the physiological and several psychological characteristics of adolescents, which include the following aspects: hand bones, muscle strength, flexibility, motor skills, proprioception, and psychological characteristics. Then, to understand

adolescent beginners better, questionnaires completed by both students and instructors in Chapter III. From survey, the problems arising from gender differences and the difficulties faced by adolescent beginners playing the piano can be observed. The result shows that age and gender differences affect piano learning, and physiological development significantly impacts adolescent beginners. Next, in Chapter IV, the contents of piano pedagogy and method books from the past three centuries are carefully examined chronologically to extract practical proposals for adolescent beginners. It reveals that learning the music theory, body coordination and relaxation first is vital for adolescent beginners. This is consistent with the results of the previous two chapters. Finally, the scientificity of piano performance postures from the aforementioned references is verified via contemporary physical and physiological theories in Chapter V. Simultaneously, practical methods for studying scales, arpeggios, finger independence, and body relaxation and coordination are also provided.

As scientific methods are and should be the trend in piano education development, my research aims to help instructors teach students with scientific concepts and to help students practise effectively to enter the music world smoothly and enjoy the fun of music.

TABLE OF CONTENTS

Acknowledgements.....	i
Abstract.....	ii
Table of Contents.....	iv
List of Tables.....	vi
List of Figures.....	viii
List of Graphs.....	x
List of Examples.....	xii
Chapter I: Introduction.....	1
1.1 The Background of The Research.....	1
1.2 The Purpose and Methods.....	11
Chapter II: Physiological Characteristics of Adolescent Beginners.....	16
2.1 Hand Skeleton.....	19
2.2 Muscle Strength.....	23
2.3 Flexibility.....	27
2.4 Motor Skill.....	32
2.5 Proprioception.....	36
2.6 Psychological Characteristics.....	40
Chapter III: The Practical Surveys on Piano Learners and Instructors.....	46
3.1 On Piano Learners.....	46
3.1.1 2018 Questionnaire.....	46

3.1.2 2019 Questionnaire.....	56
3.2 On Instructors.....	81
3.3 Piano Lesson Audit Report.....	97
Chapter IV: Piano Methods and Pedagogies for Adolescent Beginners in the Past Three Centuries.....	105
4.1 During the 18th Century.....	109
4.2 During the 19th Century.....	117
4.3 During the 20th Century.....	173
Chapter V: The Piano Pedagogy for Adolescent Beginners.....	206
5.1 Posture.....	207
5.2 Coordination and Relaxation.....	235
5.3 On Music.....	252
5.4 On Techniques.....	262
5.4.1 Scale.....	263
5.4.2 Arpeggio.....	278
5.4.3 Finger Independence.....	286
5.5 Conclusion and Supplements.....	296
Chapter VI: Conclusion.....	306
Bibliography.....	313

List of Tables

Table 2.1 Physical and physiological developments in adolescents.....	18
Table 2.2 Hand Bone Development by Age and Gender.....	20
Table 3.1 Number of respondents.....	47
Table 3.2 The age of respondents.....	48
Table 3.3 Average daily practice time.....	54
Table 3.4 The difficulties for piano students.....	67
Table 3.5 Average daily practice time.....	68
Table 3.6 Stepwise multiple linear regression analysis of the students who start piano before age ten.....	72
Table 3.7 Stepwise multiple linear regression analysis of the students who start piano after age ten.....	73
Table 3.8 The difficulties for piano students.....	79
Table 3.9 Average daily practice time.....	79
Table 3.10 The information about the students.....	98
Table 4.1 The summary of the 18th century's methods.....	116
Table 4.2 The works that Chopin recommended his students to study.....	136
Table 4.3 The summary of the 19th century's methods (a).....	169
Table 4.4 The summary of the 19th century's methods (b).....	170
Table 4.5 The summary of the 20th century's methods.....	201
Table 5.1 Chopin's practising repertoires for adolescent beginners.....	302
Table 5.2 Plaidy and Pauer's repertoires for the beginners.....	303

Table 5.3 Plaidy and Pauer’s repertoires for the advanced students.....304

Table 5.4 Plaidy and Pauer’s repertoires for the more advanced students.....304

List of Figures

Figure 2.1 Posterior view of the bones of the left hand.....	19
Figure 2.2 Hand muscles. left: palmar; right: dorsal.....	23
Figure 2.3 Synovial joint.....	28
Figure 2.4 Posterior view of the left-hand ligaments.....	30
Figure 4.1 Chiroplast.....	118
Figure 4.2 Dactylion (a).....	119
Figure 4.3 Dactylion (b).....	120
Figure 4.4 Digitorium.....	121
Figure 4.5 Contents from Bertini's method book.....	148
Figure 4.6 Deppe's posture (a).....	166
Figure 4.7 Deppe's posture (b).....	166
Figure 4.8 Breithaupt's hand position.....	178
Figure 4.9 The third-class lever.....	184
Figure 5.1 Ulnar Nerve.....	223
Figure 5.2 Mechanical analysis when playing the piano.....	225
Figure 5.3 Mechanical analysis of sitting upright.....	227
Figure 5.4 Three-hinged arches, the reaction of supports.....	230
Figure 5.5 Reactions of supports and internal forces.....	231
Figure 5.6 Mechanical analysis of hand bridge.....	232
Figure 5.7 Tendons of the left hand.....	237

Figure 5.8 Weight touch position.....	242
Figure 5.9 Mikimoto method for relaxing arms.....	243
Figure 5.10 Arm lever with the elbow as the fulcrum.....	246
Figure 5.11 Five-finger exercise hand position.....	267
Figure 5.12 the hand movements with scale exercise within an octave in B major.....	274
Figure 5.13 B major scale's resonance.....	276
Figure 5.14 Ascending scale in C major by the right hand.....	279
Figure 5.15 Ascending arpeggio in C major by the right hand.....	279
Figure 5.16 The forwards movement of the right hand when playing ascending and descending arpeggios.....	284
Figure 5.17 The vertical movement of the right hand when playing ascending and descending arpeggios.....	285
Figure 5.18 The tendon and nerves of the right hand and wrist.....	288
Figure 5.19 Mikimoto training board.....	295

List of Graphs

Graph 3.1 Interval Spans (the respondents who began study after age ten)	49
Graph 3.2 Interval Spans (the respondents who began to study before age ten)	49
Graph 3.3 The difficulties in piano playing (the respondents who began study after age ten)	51
Graph 3.4 The difficulties in piano playing (the respondents who began to study before age ten)	52
Graph 3.5 How much pain do you feel when you practice the piano.....	55
Graph 3.6 How much do you enjoy practising the piano.....	55
Graph 3.7 Participants' Grades.....	59
Graph 3.8 Interval spans (the respondents who began study after age ten)	60
Graph 3.9 Interval spans (the respondents who began to study before age ten)	60
Graph 3.10 The difficulties in piano playing (The respondents who began study after ten)	62
Graph 3.11 The difficulties in piano playing (the respondents who began to study before age ten)	63
Graph 3.12 How much pain do you feel when you practice the piano.....	69
Graph 3.13 How much do you enjoy practising the piano.....	70
Graph 3.14 Interval spans (the respondents began studying after age ten)	75
Graph 3.15 Interval spans (the respondents began studying before age ten)	76
Graph 3.16 The difficulties in piano playing (the respondents began studying after ten)	77
Graph 3.17 The difficulties in piano playing (the respondents began studying	

before ten)	78
Graph 3.18 How much pain do you feel when you practice the piano.....	80
Graph 3.19 How much do you enjoy practising the piano.....	80
Graph 3.20 The ages of piano instructors.....	83
Graph 3.21 Instructor’s teaching experience.....	84
Graph 3.22 The age that the teachers began to learn piano.....	85
Graph 3.23 The age when the male students began to learn piano.....	86
Graph 3.24 The age when the female students began to learn piano.....	86
Graph 3.25 Problems of male and female students who began piano study after age ten.....	88
Graph 3.26 Teaching materials used in lessons by instructors.....	91

List of Examples

Example 5.1 M. Clementi's Introduction to the Art of Playing the Pianoforte, Op.42, Lecon XXVIII, mm. 1-5. Leipzig: C. F. Peters. Arranged from J. Haydn's Piano Trio in G major, Hob.XV:25, the 1st movement.....	239
Example 5.2 J. N. Hummel's Piano Sonata No.5, Op. 81, the 1st movement, mm. 24-26. Braunschweig: Henry Litolff's Verlag.....	240
Example 5.3 Richardson's finger crossing exercise.....	268
Example 5.4 Plaidy's finger crossing exercise.....	269
Example 5.5 Pauer's finger crossing exercise.....	269
Example 5.6 Leschetizky's finger crossing exercise.....	269
Example 5.7 The thumb exercise in the right hand.....	271
Example 5.8 Right hand preparatory exercise in B major.....	272
Example 5.9 The exercise for fingers to move smoothly.....	281
Example 5.10 The preparatory exercise for arpeggios of Leschetizky.....	282

Chapter I: Introduction

1.1 The Background of the Research

At the end of the 16th century during the Chinese Ming Dynasty, Matteo Ricci, an Italian Jesuit priest, arrived at China's Macau and brought a clavichord to the Beijing court. It is the earliest record of the keyboard instrument from Western countries in China. We know from historical records Kang Xi, the fourth emperor of the Qing Dynasty was the first emperor to learn piano, and it is possible he was a late beginner. At the end of the Qing Dynasty, China began to implement isolationist policies, and communication with Western countries was forbidden. Contact with the outside was limited until 1840, when Western business and culture once again began to have a presence in China. Consequently, more and more modern pianos appeared in large port cities, such as Shanghai and Guangzhou. In the middle of the 20th century, the Russian composer and pianist Alexander Tcherepnin made a significant donation to Chinese piano education; then, piano learning became more accessible than before in China. In 1978, China began "Economic Reforms" termed "Socialism with Chinese Characteristics" led by Deng Xiaoping, a great president of new China after Mao Zedong. Since the Opium War, Western powers have knocked on China's gate. Under modern new China, the people have moved from humiliation to prosperity and strength. After achieving the affluence and stability we see today, more and more Chinese people

yearn for spiritual life. Learning from the Western world has become an irresistible trend. Among different fields of study, whether in science or art, we learn from the excellent aspects of Western cultures and integrate them into our 5000-year-old traditional culture. This is the purpose of the new generation of teachers and students.

With the rapid development of the economy, more and more people have started to learn Western music and study the piano. By the end of 2010, there were about five million piano learners in China. The age they began to learn piano is different, with some of them starting from childhood, some of them from a later age like middle school, and others even starting from high school or adulthood. Nowadays, with the fierce competition in society, one more skill represents one more chance to survive. Therefore, more and more parents let their children participate in various off-campus and extra-curricular classes, such as painting, calligraphy, music instruments, and dance. The increased interest in arts is driven by the cultural development of society. There were nearly nine million university graduates in 2020; many of them cannot find a suitable job to correspond to their majors. However, the students with professional skills can find jobs quickly, especially those studying art and music, resulting from the surge in social needs. At the same time, the traditional concept that a person should possess at least one survivor technique is also influencing the school education and psychological aspects between students and parents. More and more students have multiple skills, for example, they can play instruments,

painting or dancing, and when parents are aware of this, they will let their children start learning skills. Thus, the psychology of conformity or the psychology of rivalry has brought a sense of crisis to parents.

After the Chinese economic reform in 1978, the idea of Western education was brought into China and started influencing the schools' teaching strategies. For example, the contributions of Soviet Union educator Vasyl Sukhomlynsky and his particular attention to the educational and methodological bases for moral education are notable (Lovat, Toomey, & Clement, 2010). The American educator, Harvard University professor Howard Gardner (1991) listed seven intelligence items in his educational theory. They are: 1. Linguistic intelligence; 2. Logical-mathematical intelligence; 3. Musical intelligence; 4. Bodily-kinaesthetic intelligence; 5. Visual-spatial intelligence; 6. Interpersonal intelligence; 7. Intrapersonal intelligence. This is known as the multiple intelligence theory. In his book, he catalogued the extent to which students possess different kinds of minds and therefore learn, remember, perform, and understand in different ways. Inspired by it, China's nine-year compulsory education has gradually taken shape, focusing on cultivating students' overall development of morality, intelligence, physique, aesthetics and labour technology, which are called the Five Ways of Life. Take my experience as an example: In the junior high school graduation examination to enter senior high school you need to take a physical exam, including long-distance running, long jump, and shot put. For the last two years, music has also been included in the

examination. These educational concepts have become popular among schools and families, and it is that due to the schools' aesthetic education that parents began to realise the importance of overall development. Hence, even middle school students began to learn an instrument – generally, the piano. The above is one of the reasons for the increase of late beginners in the political and economic environment. Furthermore, in some areas of China, because parents are too busy with work and traffic conditions are dangerous, it is difficult for young children to go to classes alone. Thus, after children grow a little older, they are sent to participate in off-campus classes. On account of this social and environment factors, children usually start learning piano at a late age.

Beyond that, the following reasons can lead to the growing numbers of the late beginners. The diversity of students' learning purposes is the first reason for the more significant number of late beginners. Some of them are forced to study piano by their parents. Except for the reasons mentioned above, Chinese parents often have the traditional view that if children are not good at school studies, they should study art or some craft skills so when they enter society, they can survive by themselves. This expectation from parents informs students' learning purpose. Some students genuinely like music and want to learn music from the heart. In a Chinese school's music class, teachers usually teach students how to appreciate Western music, and some schools even provide pianos for students to take piano lessons after classes. As a result, some students ask parents if they can participate in off-campus classes to gain a deeper understanding of Western

music. Also, some students plan to take the art entrance examination or enter the university as art majors in the future. Students may choose to attend an art university if they have entered senior high school and realised that they could not go to a good university, or if someone thought they could not pass some required courses. As more and more students take this path, a training institution in China called Art College Entrance Examination Training was implemented.

I had some experiences teaching piano students who were preparing for the conservatory of music entrance examination from 2013 to 2015 in the training institutions. Almost all of the students started piano study at a late age, around 15 or 16 years old, and during that time, they were going to participate in the college entrance examination after 9 or 10 months. Among them, the proportion of male and female students was almost the same, but the level of piano performance was quite different. Some of them were studying sonatas of Mozart or Haydn; some of them were learning Czerny *Etudes Op. 740*; some of them were practising Chopin etudes. They chose their majors according to their piano level and the advice from the teachers at the conservatory of music. My one male student played the Chopin *Etude Op. 25 No. 12 "Ocean"*, and he was finally admitted as a piano major in the Music Education College of Sichuan Conservatory of Music. This student was also a late beginner, but he was better than other students in his musical understanding. Other students were admitted to the same college as vocal majors, music management, and music education majors. Moreover, some students entered the Music College of Sichuan Normal

University to study music education. Unfortunately, none of the students could be admitted as piano performance majors.

When I taught them, I found that some students had poor self-control and were easily tempted by various distractions, such as mobile games, delicious food, and shopping. Because after they have been through years of education and accrued experiences from their abundant modern lifestyles, they have formed their habits and obtained various interests. This leads them to desire to make more choices for themselves when they face challenges rather than listening to their parents. And this is one of the most significant differences between adolescent and early child beginners. It goes without saying that late beginners have more advantages than younger beginners in the aspects of psychology and cognitive. Nevertheless, younger beginners have more advantages than late beginners in some aspects, such as the potential development of locomotor organs, ears training, and more possibilities in teaching methods. Additionally, when I teach the late beginners, I found that some techniques like trills, double-notes and even scales and arpeggios were tricky for those students. It brings challenges for them to achieve their goals in a short time. Consequently, I will discuss these problems and solutions in the following chapters.

Other students are confident that they can get good scores in the college entrance examination. However, if students have artistic ability, they can take part in some special examinations in more excellent universities. These

universities can provide more favourable admission conditions, like lowering the admission score for artistically gifted students. Therefore, some students start to study an instrument after entering middle or senior high school, and they are called speciality music students. A certification is needed to take such a special examination, and students can participate in the National Social Art Grade Examination to gain the certification. In China, the following institutions mainly hold examinations and issue certificates: The Grade Examination Committee of China Conservatory of Music, Central Conservatory of Music, Shanghai Conservatory of Music, and Chinese Musicians' Association. However, today, no matter what age group, most people will take the examination held by the above institutions as long as they are learning musical instruments because this is not only an affirmation of their learning achievements at this stage, but also a kind of psychological encouragement and a certificate to prove their cultural strength.

In China, there are a lot of excellent comprehensive universities recruiting students with an art speciality. It is a policy that while examinees are participating in the normal college entrance examination, they can join in the particular art examination of those comprehensive universities so that the examinees can be recruited with lower entrance scores than those examinees who only participate in the normal college entrance examination. In 2018, there were

some universities¹ recruiting piano speciality students. Notably, in the enrolment content of Donghua University, the piano is a significant development project of the School Art Troupe.² The colleges or universities that recruit speciality music students each year are different. The majors recruited are determined according to the musical instruments required by the school orchestra or college orchestra in that year. These excellent universities pay attention to students' overall quality and all-around development. The policy prompts more students to learn musical instruments to enter a better university. Nevertheless, in another sense, western music has been widely promoted in China's education.

Due to these policies and music education experiences in modern China, we have a new understanding of how to cultivate students' interests and hobbies. These speciality music students are one of the products. With the further improvement of the multiple selection systems, I believe that diversified enrolment will become a reality. Today's college entrance examination is no longer the "naked score" era as in the past, nor is it the standard policy of bonus points. Instead, it shows a conception of selective education that is much more

¹ For instance, Huazhong University of Science and Technology, Northwest A&F University, Nanjing Agricultural University, China University of Geosciences, Northwestern Polytechnical University, Southwest Jiaotong University, Hunan University, China Pharmaceutical University, China Agricultural University, China University of Political Science and Law, Tianjin University, Beijing University of Chemical Technology, Donghua University, and Wuhan University. In 2019, there were Huazhong University of Science and Technology, China Pharmaceutical University, Donghua University, Beijing Institute of Technology, Wuhan University, etc.

² Admission brochure of Art Troupe <http://www.51gaoxiao.com/gaokao/ystcs/jz/index.html>

comprehensive, reasonable, and impartial.

Another reason for adolescent beginners increasing is that the elementary school assigns a lot of homework. When I was in elementary school, the teachers usually assigned math, Chinese, and other subjects as my homework. Every day when I came back home from school, the first thing I had to do was my homework, and after I finished my homework, I then had to read a large number of extracurricular books, which the school teacher also required. Most of my classmates had a similar daily life at that time. Research from Ma (2019) shows that students' academic loads mainly come from the demands of school and family, and homework time is the most influential factor of students' subjective feelings about their academic burden; the subjective feelings of burden affect not only their learning motivation and academic achievement but also their overall development.

According to a 2018 notice³ from the Ministry of Education of the People's Republic of China on reducing the burden on primary and middle-high school students, the total amount of homework should be strictly controlled in primary and secondary schools. The notice emphasised that homework should not be assigned in grades one or two of primary school, and no more than 60 minutes per day should be spent doing homework in grades three to six. We hope that

³ Ministry of education of the People's Republic of China

http://www.moe.gov.cn/srcsite/A06/s3321/201812/t20181229_365360.html

schools will implement the curricular of the Ministry of Education as soon as possible, make reasonable adjustments to students' homework, respect the individual differences and nature of students, protect their imagination and creativity, and promote the overall development of the school environment.

For those adolescent beginners, the pedagogies used now also have their advantages. From my experiences, those students who will participate in the college examination have to practice Charles-Louis Hanon's *The Virtuoso Pianist in 60 Exercises* a lot. Its exercises 1 ~ 20 are called "preparatory exercises"; exercises 21 ~ 43 are called "further exercises for the development of a virtuoso technique"; exercises 44 ~ 60 are called virtuoso exercises for mastering the most outstanding technical difficulties". Students are required to practice exercises 1 ~ 20 every day with a high finger motion, then progress according to their practice. Depending on the major they intend to apply for, they must choose the piano pieces for the examination. On the teacher's side, they teach students through their learning experiences and long-term teaching experiences. A few teachers spent a long time guiding such students; hence they developed several unique pedagogies. However, most teachers are extensively experienced in guiding early beginners but inexperienced in teaching adolescent beginners. As the number of adolescent beginners increases, those teachers have to teach as well. Therefore, they are using the same teaching materials and methods to instruct adolescent beginners. Those teachers who usually teach adolescent beginners the same way as early beginners have already become the

standard in piano teaching around China. They teach the staff first, then strike the key with a single hand using Ferdinand Beyer's textbook *Vorschule im Klavierspiel Op.101* (English Version: *Beginning Piano School or Elementary Instruction Book for the Piano*); meanwhile, students practice finger strength and independence by using *The Virtuoso Pianist in 60 Exercises*. After several months of training, Carl Czerny's *Etudes Op. 599* introducing practical exercises for beginners is used. If there are talented students, Carl Czerny's *School of Velocity Op. 299* is also used to guide them after a careful study of *Etudes Op. 599*. Indeed, several pieces of J.S Bach's *Inventions and Sinfonias BWV 772 ~ 801* are also taught during the learning progress.

First of all, these pedagogies cannot significantly improve the students' piano performance in a short time. Secondly, practice that only aims at the examination will train a student to be a real performance machine. Finally, even if they successfully enter the music school, such experience will also cause students to form an undesirable model of thinking and foster bad practising habits in their future music learning. Therefore, this study will solve these problems one by one and bring the gospel to those adolescent beginners and their instructors.

1.2 The Purpose and Methods

This research will explore effective piano methodology and teaching strategies in a scientific way for students who began their piano education in

adolescence. In the long history of piano method development, tradition and the personal experiences of the teachers themselves have been the standard methods used in their research. Only a few approaches were far-sighted and followed the trend of world science and information development, which has injected new insight into piano playing. Although these methods also drew conclusions from instructors' personal experience, they did not rely solely on subjective assessment, but also consulted and studied past teaching materials approached from an objective perspective and modern educational standpoint. However, most of those past materials and methods are explained in the form of hypotheses. Although they seem clear and reasonable, their effectiveness in practice has not been verified yet because of the backwardness of the scientific equipment and an inadequate understanding of interdisciplinary concepts. In the 21st century, many researchers in the world have verified these hypotheses one by one through contemporary scientific means. Thus, many teachers realised the importance of science in piano playing and began reading many of these advanced research results, and they have updated their teaching methods accordingly. Consequently, the core methodology of this research is to provide a set of practice approaches for adolescent beginners by referring to new scientific insights.

In order to approach adolescent beginners, the first thing we should do is to know the characteristics of the students. After consulting the relevant literature, I have summarised the physiological properties of adolescent students related to piano performance. This summary is also informed by the physiology that I

studied for four years during university, including the musculoskeletal system, the nervous system, and soft tissue.

A questionnaire survey was used to obtain information about the difficulties encountered by students in piano learning. Information about the teachers' strategies and the problems they are aware of with these students was also obtained. The questionnaire survey was conducted three times: The first time in Japan using a paper questionnaire; the second time an online questionnaire survey was used to collect data from Chinese participants; for the third time an online questionnaire was used to collect data from instructors in Japan. The results have been analysed using statistical software SPSS. Frequencies and descriptive analysis were used to calculate the proportion of the items, such as the number of the participants who selected different levels of playing difficulty; linear regression was used to analyse the factors affecting daily practice time. The classification of playing difficulties used the KJ method (affinity diagram) in the first survey. The second time it was carried out in the form of multiple choices according to the classification results of the first time. Furthermore, I audited the lessons of non-speciality students, including several adolescent beginners, and interviewed them after the lessons.

Next, I looked up and studied thirty-five method books from the past three centuries, and I found some methods that can be taught to adolescent beginners. Thus, according to the questionnaire survey results, I have extracted the methods

related to the following contents and briefly described their suitability for adolescent beginners: playing posture, the description of muscle and bone function in piano playing, finger independence, physical exercises, and scales and arpeggios. In this part, I also summarised the development and current state of piano music education.

Finally, according to the results above, the methods for adolescent beginners and pedagogies for instructors have been preliminarily formulated. I have analysed the relevant aspects of playing posture through calculus and proved the influence of external force on playing by using physical mechanics theory, which includes using the principle of the lever to explain the mechanism of the playing apparatus. In addition, I combine the research results of various disciplines, including psychology, physiology and pedagogy, which provide a theoretical grounding for the proposed piano methods and pedagogies.

The methods utilised in this study combined arts and science, showing the value of an interdisciplinary approach. It can help develop a scientific and comprehensive piano method. In contemporary society, it is indispensable to research with a scientific concept. Only by using scientific ways, the problems can be solved reasonably and efficiently. Nevertheless, although many scientific methods have been applied in music research, the research on piano teaching still remains at the experience teaching or teaching based on the correct methods verified by data. However, there are no revolutionary and new methods that have

been introduced. Therefore, we should inject new strength into piano education research by using the scientific and reasonable means and with the concept of interdisciplinary, which is the central guiding ideology of my research. And I believe it should keep in line with the development trend of the world. I wish that piano students can quickly master their physical skills and genuinely enjoy the music as soon as possible.

Chapter II: Characteristics of Adolescent

Beginners in Piano Learning

Adolescence is full of rich experiences and changes for all of us, such as social practice, personal relationships, and emotional development. This period will shape our adult personality, values, outlook on life and will influence our future living habits, work, and study. We will experience significant physical and psychological changes, which influence not only our life and learning but also the coping strategies of both parents and educators; their instruction and guidance should be tailored to the adolescent's unique development. In this process patience is important. Similarly, in piano teaching, it is not proper for adolescent beginners to blindly use the same textbooks and teaching methods applied to children's piano education. There are many differences in learning between the two types of students. The posture of piano playing is different due to different body types; the body's movement patterns are different due to their physical and physiological development; their ways of understanding and receiving music are also different. Therefore, it is urgent to design a set of targeted and efficient pedagogies and practice methods, and it ought to be built on the adolescent physical, physiological and psychological characteristics.

During education, especially in music instruments education, instructors cannot efficiently guide students at a complicated and volatile developmental

stage unless instructors have a good grasp of the characteristics of adolescents with respect to their physiology and psychology sides. Especially the physiological maturity in adolescents is remarkable, and these kinds of changes cause plenty of fundamental differences compared to childhood. Consequently, realising the physiological changes of adolescence will help instructors find dependable, available, and distinctive methods for adolescent beginners.

Adolescence is usually associated with puberty. On average, puberty starts from preadolescence. The puberty span among girls is around ages 10 ~ 17 years, while for boys it lies during the ages of 11 ~ 18 years. This period is accompanied by significant changes both physiological and psychological, such as musculoskeletal growth, nerve system maturation, mental maturation, and other aspects. In addition, as I mentioned in the last chapter, many adolescent students are easily influenced and attracted by the surrounding environment, such as the temptation brought by entertainment facilities and relaxation places. These internal and external factors jointly guide the development track of adolescence.

There have been multiple documents about adolescent development. However, this chapter only summarises several physiological aspects closely associated with piano playing, such as hand skeleton, muscle strength, flexibility, motor skills, and proprioception. Moreover, in the last part, I chose and summed up some psychological research, including research about the relationship between adolescents and their parents, adolescent emotions, and some

discrepancies between female and male adolescents.

Here, as a preview, I listed a summary of physical and physiological developments in adolescents (Brown, Patel, & Darmawan, 2017).

Table 2.1

Physical and physiological developments in adolescents

	Early Adolescence (10-13 years)	Middle Adolescence (14-16 years)	Late adolescence (16-20 years)
Male	<ol style="list-style-type: none"> 1. Rapid physical growth and motor skills development 2. Sharp increase in muscle strength 	<ol style="list-style-type: none"> 1. Speed peak before PHV, strength and power peaks follow PHV⁴ 2. Continue to improve motor performance throughout adolescence 	<ol style="list-style-type: none"> 1. Strength, speed, and size are developed continually but get slower.
Female	<ol style="list-style-type: none"> 1. Experience puberty earlier than male 2. Gradual improvement in muscle strength 	<ol style="list-style-type: none"> 1. Perform better in balance tasks 2. Do not improve in motor performance after age 14 years. 	<ol style="list-style-type: none"> 1. Muscular strength continues to increase into adulthood.

Note: This table demonstrates the adolescent development of motor skills, muscle strength, and other physical and physiological features between males and females.
(Made by the author)

The three stages of development in adolescence and the quantitative changes

⁴ PHV: peak height velocity reflects the maximum of biological maturity in adolescence.

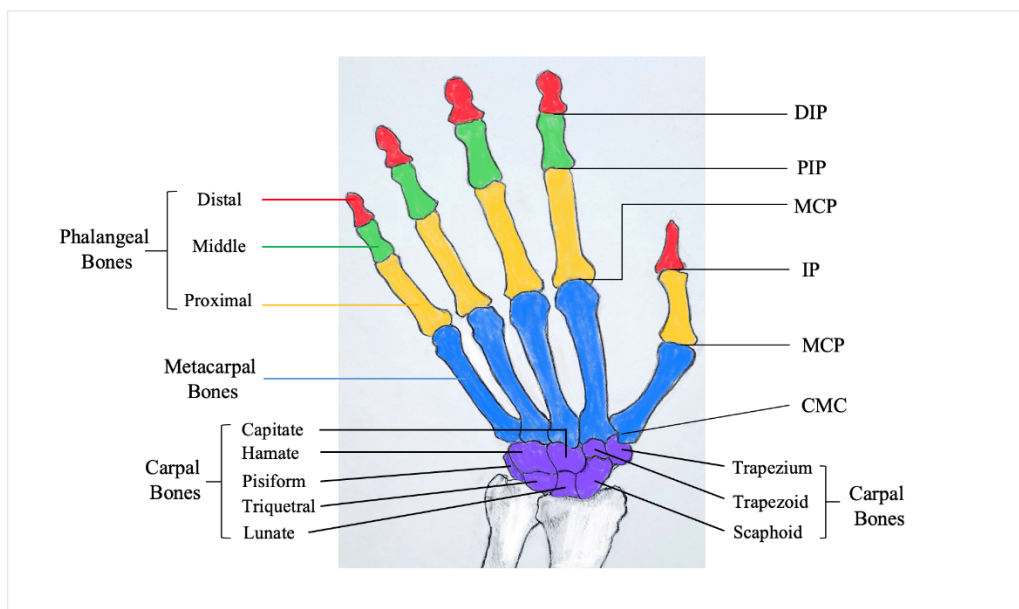
they entail have brought many challenges to piano teaching. The macro development which is visible and the micro development which is invisible helps us better understand Matthay's visible and invisible theory in piano performance, which will be mentioned in the following chapters. Then, the following will introduce the development of adolescents from macro to micro.

2.1 Hand skeleton

In anatomy, the hand's bones are divided into three parts: carpals, metacarpals, and phalanges, see *Figure 2.1*.

Figure 2.1

Posterior view of the bones of the left hand



Note: The figure shows the bone structure of the left hand. (Made by the author)

The purple areas are carpal bones, blue are metacarpal bones, yellow, green,

and red are phalangeal bones. In the phalanges area, the red part is called the distal phalange; the green part is the middle phalange; the yellow part is the proximal phalange. The joint between the distal and middle phalange is the distal interphalangeal joint (DIP), which is called the first joint in piano teaching; the joint between the middle and proximal phalange is the proximal interphalangeal joint (PIP), which is called the second joint; the joint between proximal and metacarpal is the metacarpophalangeal joint (MCP), which is called the third joint; at last, the joint between metacarpal and carpal is the carpometacarpal joint (CMC). This joint is unique to the thumb and is also the active part of the thumb when playing the piano. As the figure shows, the structural components of the thumb bone are different from other fingers. The thumb is without the DIP. Instead, it has the interphalangeal joint (IP), and has none of the middle phalange.

The carpal bones consist of eight small bones. The development of hand bones during adolescence is shown below (Gilsanz & Ratib, 2005).

Table 2.2

Hand Bone Development by Age and Gender

Bones Age	Carpals	Metacarpals	Phalanges
Female: ages 2-7 Male: ages 3-9	Epiphysis of all carpal bones are recognisable	Epiphyses increase in width and thickness	Epiphyses increase in width and thickness * The size of the epiphyses in distal phalanges get bigger

			than middle phalanges
Female: ages 7-13 Male: ages 9-14	All carpals become bigger and recognisable	1. The contours of the epiphyses start to overlap the metaphysis. 2. The preparation for fusion	
Female: ages 13-15 Male: ages 14-16	Rudiment shaped	Fusion	Fusion (Distal, middle, and proximal)
Female: ages 15-17 Male: ages 17-19	Completely developed		

Note: The table shows the epiphysis period of knuckles in different genders during adolescence. (Made by the author)

Because the epiphysis is covered cartilage in the joint, it is associated with hand stiffness and flexibility. As shown in *Table 2.2*, the epiphyseal fusion of phalanges occurs around 13 ~ 15 years old in females and 14 ~ 16 years old in males. The eight bones in the carpal mature around 15 ~ 17 years old in females and 17 ~ 19 years old in males. However, Cardoso and Severtino (2020) shows that epiphyseal fusion of the hand bones occurs around 12 ~ 18 years old in females and 16 ~ 18 years old in males; the age of development is earlier; as the secondary ossification centre in adolescence, epiphyseal fusion also occurs in wrist joints. Therefore, this development stabilises the joints and improves the firmness of bones. The changes of these bones have a profound impact on the learning and practice efficiency of adolescent piano beginners. The changes of these bones have a profound impact on the learning and practice efficiency of

young piano beginners. At the same time, bone mass is also very significant in adolescence and affects their motor skill.

Bone mass is used to measure the mineral content of bones, is closely related to bone metabolism, and has an important impact on bone strength. Bone mass increases with age, making the bone stronger and more rigid. Although the stronger bones can help provide better hand support, the hand will lose more softness in key touch. Many factors affect bone mass, such as gender, changing age, and bone mineral density (BMD). In all adolescence, males show higher levels of BMD than females throughout the body (Arabi, et al., 2004). Males present higher BMD values at the femoral neck, whole body, hip, and arm, while females present higher values at the lumbar spine (Krahenbühl, Gonçalves, Costa, & Filho, 2014). Gender difference play a critical role in the hardness of bones, which could affect the posture of piano playing, the position of hands, and the coordination of the whole body. From a microscopic point of view, the development and maturation of skeletons are also interacted by osteoblasts (bone-forming cells) and osteoclasts (related to monocyte or macrophage cells). The former promotes the connection of bone cells, and the latter decomposes and destroys bone tissue. Moreover, both types of cells do not decrease during adolescence, or indeed, until old age (Becerikli, et al., 2017). Therefore, the skeleton during adolescence is in a state of constant renewal.

Bone mass reaches its peak on puberty. And in puberty, the skeletal strength

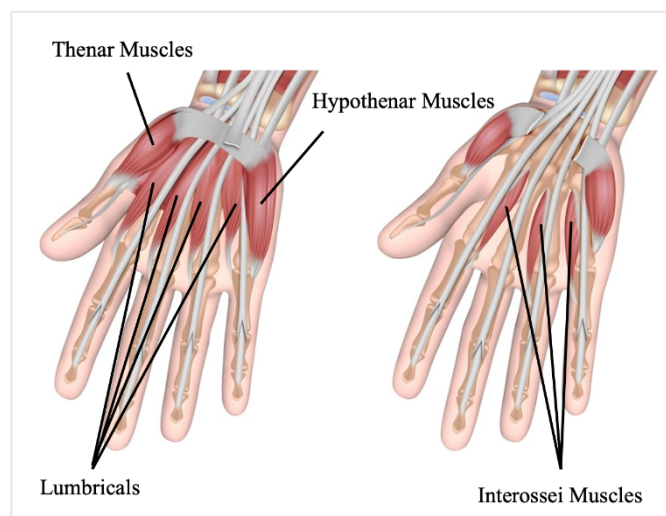
attained a more remarkable development. Furthermore, physical activities can improve bone density and strength until early adolescence (Levine, 2015). Therefore, even in early adolescence, there is still a chance to improve skeletal strength by using physical exercise, for example, finger exercises. This will be explored in Chapter V.

2.2 Muscle strength

Muscles of the arm and shoulder help play powerful music. In most cases, we play with our fingers, so finger power becomes particularly important. I suppose that most beginners have practised *The Virtuoso Pianist* composed by Charles-Louis Hanon – it is an exercise for strengthening fingers. However, there are no muscles in our fingers, as shown in *Figure 2.2*.

Figure 2.2

Hand muscles. *left: palmar; right: dorsal*



Source: Muscles of the hand. Retrieved from <https://www.pond5.com/stock-images/illustrations/item/43425392-muscles-hand-palmar-view-unlabeled>
(Accessed on Feb 28, 2022)

These muscles guide the different movements of the fingers. Interossei muscles between bones function to bend the MCP joints. The four dorsal interossei muscles guide fingers away from each other; the three palmar interossei muscles guide fingers pulling together. Lumbricals are located at the knuckle to help straighten the fingers and bend the MCP joints. Hypothenar muscles consist of three small muscles: the abductor digiti minimi that helps the little finger bend with the MCP joint; the flexor digiti minimi that guides the little finger as it pulls towards the ring finger; and the opponens digiti minimi that helps the little finger move towards the thumb. Finally, the thumb muscles are the most complex. The main part is the thenar muscles group, which consists of three muscles: the abductor pollicis brevis that guides the thumb to move in a direction perpendicular to the palm; the flexor pollicis brevis that guides the rotation of the CMC joint and the movement of the MCP joint; and the opponens pollicis, which is the most important muscle to help the tip of the thumb touch other fingers' tips and is the primary dynamic source for grasping. The strength of the fingers comes from these hand muscles, and the firm and stable phalanx and knuckles are the foundation that ensure the strength of the fingers.

There is a relationship between grip strength and finger strength. The middle finger has the largest share of grip strength, followed by the ring finger, index

finger and little finger (Ohtsuki, 1981). However, grip strength is also related to age. Male grip strength will increase explosively after puberty until 25 ~ 30 years old, but the female will increase gradually; at the same time, bone strength and grip strength also affect each other (Schönau, et al., 1996). This provides a scientific basis for determining how to train teenagers' finger strength when practising the piano. In order to improve finger strength, hand muscles are the key, followed by solid hand bones and knuckles.

During female adolescence, Lang (2011) explains that because of higher oestrogen levels, the mass and strength of bones and their corresponding muscles increases rapidly; however, in young adulthood the level of oestrogen starts to decline and the skeleton's responsiveness to exercise declines faster than in males. On the other hand, the male adolescent with a high level of testosterone increases muscle mass and strength. In this period, the development of bone and muscle is concurrent (Riggs, Melton, & Robb, 2004). Furthermore, there are mainly two aspects to the development of muscle forces in males: bone dimensions and strength (Lang, 2011). Therefore, different hormone levels in males and females lead to different muscle and bone development patterns, resulting in different training conditions of hand strength in adolescence. Our muscle strength is related to bone structure and gender differences; moreover, the development of bone and muscle mass and strength continues longer in males than in females after puberty. Therefore, in practice, we should not only consider how to improve muscle strength but also pay attention to the playing posture of

the hand. It is related to the stability of hand bones and knuckles and impacts finger strength.

Regarding the development stages of muscle strength, Gaston and Malina show that both males and females tend to increase muscle strength during the whole of adolescence. However, males increase muscle strength from early childhood until 13 or 14 years old, followed by a significant acceleration until the early or mid-20s; Females improves muscle strength later than males, at around 15 years old. (Gaston & Malina, 1988) On the other hand, the gender differences in muscle strength are more present in the upper extremities and the trunk (Lillegard, Brown, Wilson, Henderson, & Lewis, 1996). It follows that instructors should notice both hand and upper limb positions. Simultaneously, they should know the development schedule of muscle strength and choose the scientifically correct period to improve hand muscle strength.

Hand muscle strength plays an important role in piano playing. It is influenced by gender, hand dominance, and other factors such as hand bones and neurophysiological mechanisms (Chen, McGee, Rich, Prudente, & Gillick, 2018). Also, the handgrip can directly reflect hand strength. Adolescent males have higher handgrip strength than females, and interestingly, physical activity and energy, carbohydrate intake, and fat associate positively with handgrip strength in males (Ng, Hairi, Jalaludin, & Majid, 2019). It is necessary to improve finger and hand strength by physical exercise, and we should focus on handgrip strength;

also, we should note that nutrients are also necessary for improving muscle strength.

2.3 Flexibility

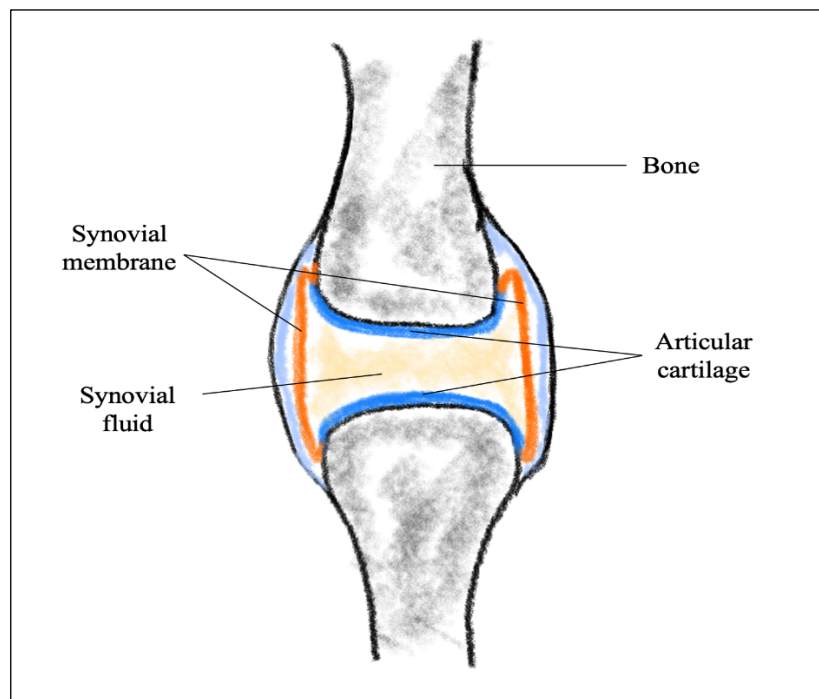
It is widely known that stiffness of movement is related to lubrication liquid within joints called synovial fluid, the thickness of cartilage, and the mobility of ligaments. With the decrease of synovial fluid, cartilage tends to become thinner, and ligaments get shorter, causing movement to be stiff and inflexible.

There are seven types of synovial joints: 1) gliding joints – a joint that allows the bone to glide left and right, such as carpal bones; 2) hinge joints – a joint that allows the bone to move up and down but cannot move left and right; 3) pivot joints, which may rotate externally (e.g., rotating the arm outward) or internally (e.g., rotating the arm inward); 4) condyloid joints – a joint allows the bone to move back and forth or left and right relative to each other, such as the joint between the wrist radius and the wrist bone; 5) saddle joints – a joint allowing two bone blocks to move bidirectionally along the other bone block, such as the CMC joint in the thumb; 6) socket joints – the most flexible type of joint, which allows the bone to rotate freely in all directions, such as the shoulder joint; 7) compound or bicondyloid joints – a joint that can move along two different axial planes with a wider range of motion range than condyloid joints, such as the knee joint. These synovial joints have five functions: 1) abduction – moving away

from or towards the centre of the body; 2) adduction; 3) extension; 4) flexion – bending joints; 5) rotation. These movements are frequently used in piano playing. However, the synovial fluid in the synovial joints secreted by the synovial membrane decreases with age. Synovial fluid helps joints reduce friction and absorb collision. There is no evidence to show that synovial fluid decreases during adolescence, but there can be an abnormal level caused by a lesion, such as arthritis.

Figure 2.3

Synovial joint



*Made by the author

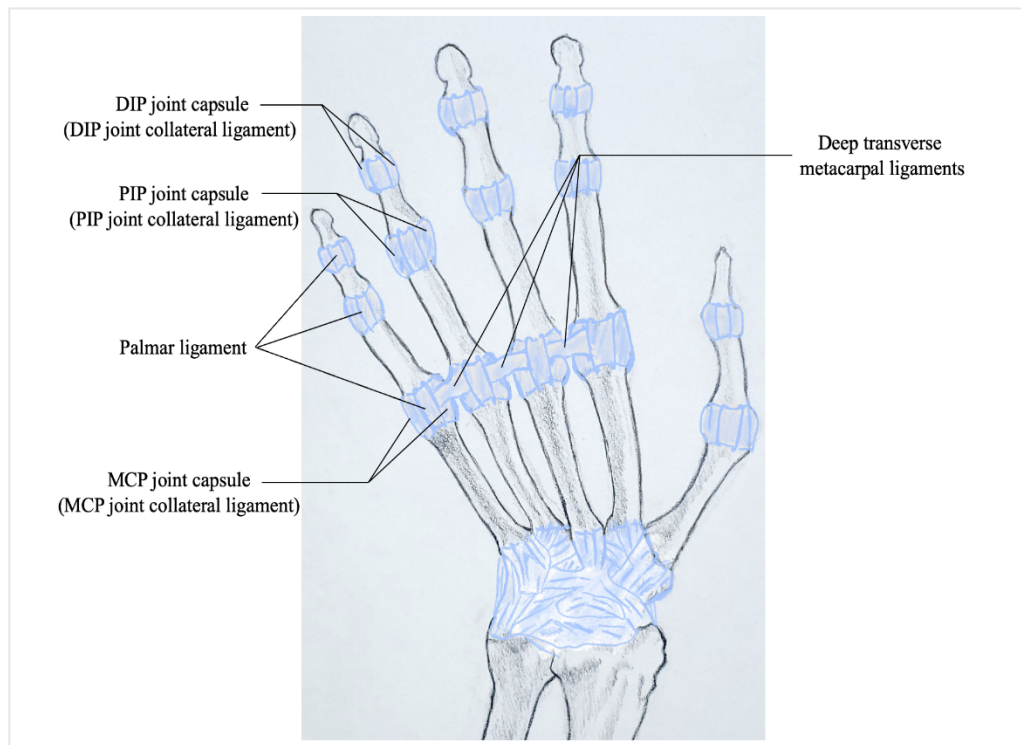
The articular cartilage makes joints move smoothly, lubricates joints, and copes with a part of friction. With increasing age, the cartilage gets thick, and

because of the decreasing hydration of the matrix, the cartilage loses its ability and becomes stiff (Fox, Bedi, & Rodeo, 2009). In addition, the cartilage thickness is not found in children under six years old, but the cartilage of adolescent boys is thicker than in girls of the same age (Spannow, Jensen, & Andersen, 2010). Thus, the result indicates that physiological differences are caused by sex hormones and perhaps relates to genetic factors. Therefore, the thickness of cartilage has a significant impact on the physical flexibility of adolescent men.

Ligaments can protect joints, prevent overextension, and decrease the possibility of fractures or sprains caused by excessive motions. Meanwhile, ligaments guide joints to move fingers normally under external force loads and distribute these loads to maintain the proper function of joints. There are different kinds of ligaments in the hand, shown in *Figure 2.4* Retinacular ligaments keep the position during PIP and DIP flexion; MCP joint collateral ligaments stabilise the MCP joint; deep transverse metacarpal ligaments limit metacarpal splay away from the centre of the metacarpal bone; the DIP, PIP, and MCP joint collateral ligaments are situated at the other side of their joint capsules.

Figure 2.4

Posterior view of the left-hand ligaments



*Made by the author

Ligament links one bone to another bone, while tendons link muscle to bone. Both are related to limb kinematics and influence body flexibility, smoothness, and precision. Although in early to mid-adolescence skeletal growth occurs before musculotendinous growth (Gaston & Malina, 1988), it causes a decrease in musculotendinous flexibility, particularly among male adolescents (Roemmich & Rogol, 1995). On the other hand, the intrinsic elastic features of the musculotendon are affected by muscular activation capacities in children before age 10 (Lambertz, Mora, Grosset, & Pérot, 2003). Therefore, body flexibility among adolescents tends to decline and become stiffer, and this will

have an influence on the adolescent beginners of piano, especially with regard to keystroke, arpeggio execution, and other techniques that need coordination among different locomotor organs. Also, it prevents the practice of finger independence and flexibility to a certain extent.

Recent studies show that there are internal and external factors that influence body flexibility. Brown and Darmawan explained that internal physical factors such as muscle volume, bone structure and muscles, tendons, joint capsules, and ligaments contribute to tissue elasticity. On the other hand, external factors include environmental factors of temperature and human factors such as warming up before sports or physical exercise. (Brown, Patel, & Darmawan, 2017) It is the evidence that warming up and doing physical exercise before practice, concerts, or after lessons will help fingers quickly obtain more flexibility and control. However, those movements and motor abilities are dominated by the musculoskeletal system. The musculoskeletal and physical flexibility in females is more pronounced than in males, furthermore, flexibility tends to decrease from mid-adolescence in males, while in females it increases slightly during early adolescence and typically plateaus at 14 ~ 15 years old (Brown, Patel, & Darmawan, 2017). Moreover, girls show greater flexibility at all years (Gaston & Malina, 1988). This demonstrates that besides age, gender differences are also a factor impacting body flexibility.

2.4 Motor skills

Motor skills are a learned ability that depends on the function of the brain, skeleton, and nervous system, and which effectively applies skeletal muscle to complete a movement correctly and economically. In other words, it can accomplish an action as accurately as possible in the shortest time and in the most economical way. Motor skills rapidly develop and become more sensitive around 3 ~ 5 years old, mainly reflecting the significant nervous system changes that occur during this period. Also, humans' movement abilities in this period are widely improved. Gaston said that motor skill development related the age but also depending on age. In the early adolescence, males with the rapid development in motor performance, but females develop motor performance only until about 13 or 14 years of age and after that with a bit subsequent improvement. (Gaston & Malina, 1988) Until mid-adolescence, agility, coordination, strength, and action speed are developing, but females do not improve motor performance after 14 years old; in late adolescence, almost all adolescents have reached the end of physical development (Branta, Haubenstricker, & Seefekdt, 1984). Therefore, in the development of motor skills, gender differences have a great influence. Compared with males, females' development period is shorter. To the adolescent, the learning motor skills tends to be difficult. Thus, physiology dictates that this time should be reserved for adolescent beginners to learn and practice the basic techniques. Meanwhile, due to the age-related motor skill development, finding a highly efficient method for adolescents is also a challenge

for instructors.

Motor skills are an internal collection of muscle activities that include gross and fine skills. Gross motor skills guide the body to learn and perform big movements like posture, balance, running, and jumping using large muscles, and these develop during childhood; fine motor skills guide the body to move fingers, hands, and feet using small muscles, they are usually related to the commands of the nervous system, and they develop before preadolescence. There are three studies from Smahel and Klímová about the mobility of metacarpophalangeal joints (MCP) – wrist, flexion of proximal (PIP) – distal (DIP) interphalangeal joints, and thumb joints. These studies objects include university students, senior citizens, and pianists, and each group contains males and females. The results reveal differences in the phalangeal joints' mobile abilities between pianists and non-pianists, and the influence of gender differences on mobile abilities between university students and senior citizens. Furthermore, this result can be used to explain the data statistic results of Chapter III indirectly.

About the mobility of MCP joints, Smahel and Klímová shows that the mobility and range of extension is better in females than males. This difference is more significant in the senior citizens' group than the university students' group, showing that gender and age are both related to the mobility of MCP joints. The pianist group shows greater finger mobility than other groups; the dorsopalmar movements in males have better mobility in the left hand.

Furthermore, the MCP joint range of motion in dorsopalmar movement is more significant in the little finger among pianists, and the smallest in the index finger among senior citizens. (Smahel, Z & A Klímová, 2004a) This reveals that the hand and finger not used often can become more flexible through systematic training. Among all research subjects, the MCP joint range of motion in the left hand is more remarkable than the right hand and is better in females than males. The MCP joint is a vital part of piano keystroke; therefore, its physiological characteristics in different genders and ages play a role in this research.

Regarding PIP and DIP joints, Smahel and Klímová concluded that among the three groups, the PIP joint of the little finger, and the DIP joints of the index and ring fingers have the smallest flexion; in the university student group, the flexion of PIP joints in females is more significant than males. Among the pianists, the gender differences are not significant because all of them obtained professional finger exercises, which is to say the long-term systematic training can reduce the differences brought about by gender. Comparing the senior citizens' group and university students' group, senior citizens show more pronounced limitation in all PIP and DIP joints than university students, while pianists show the same level of flexion as students. (Smahel, Z & A Klímová, 2004b) This shows that the PIP and DIP joints will lose their mobility with increasing age if there is no intervention of external factors.

As for thumb joints, the Smahel and Klímová measured flexion of

interphalangeal (IPP) and metacarpophalangeal (MPP) thumb joints. The flexion variability of MPP is greater than IPP. All measurements of flexion and hyperadduction among the senior citizens have found limitations; mainly, the limitation of thumb hyperadduction in males is more significant than in females. Although the pianist group shows greater thumb hyperadduction, the greater flexion only in the MPP joint of the males. (Smahel, Z & A Klímová, 2005a) The thumb as a multifunctional member plays an important role in piano playing; its flexibility and motor skill are related directly to almost all basic techniques. Gender and age are the factors that influence the motions of the thumb, and this informed my search for a method, probably physical exercise, to help adolescent beginners improve thumb function.

In conclusion, all phalangeal joints' mobility declines and limits some movement ranges with the increase of age. However, this phenomenon was not found among pianists because they received long-term professional training, which slows down the phalangeal motor skills decline and reduces the differences caused by gender.

Furthermore, Smahel and Klímová examined four aspects of wrist mobility within various groups: flexion, radial duction, and the range of dorsovolar and radioulnar movements. The left and right wrists among student, senior and pianist groups did not show apparent differences. However, both the student and senior groups show greater mobility in females with fewer limitations than males in the

four areas of mobility, except for flexion in females of the senior group. In particular, the females of the senior group showed a bit of limitation in ulnar duction. On the other hand, the pianist group shows greater ulnar duction than students, and compared to the senior group, males have a greater range of dorsovolar and radioulnar motion than female pianists. (Smahel, Z & A Klímová, 2005b) This shows that gender differences lead the variabilities in motor skills. Movements controlled with large muscles usually show a higher ability in males than in females; the gross motor skill decides the result. However, with systematic practice, the wrist motor skill of males will even surpass females because the males seem to have high potential in that area.

In addition, motor skills mould posture, movement procedures, and the nervous system. Meanwhile, the alteration of body movement perception is associated with piano playing posture and techniques such as jumps and octaves; it might be due to pure sensory decline and the alteration of the motor system with increasing age (Landelle, Ahmadi, & Kayounoudias, 2018). Therefore, instructors should consider the influence of motor system development in adolescence when teaching posture or finger movements.

2.5 Proprioception

Proprioception is mediated by proprioceptors, which are sensory receptors located in muscles, tendons, and joints. Proprioception is associated with the

feeling of limb position, movement, balance, and weight, and can be considered the information collecting station for learning motor skills. Proprioceptive development occurs between the ages of 5 and 18 years, mainly in the improvement of precision, however, the sensory response variability decreases with increasing age (Holst-Wolf, Yeh, & Konczak, 2016). Although adolescent students can improve their precision by repeated practice, the sense of keyboard resistance will be more unresponsive with decreasing sensory receptors. Therefore, late beginners find it difficult to produce good sound quality with a short amount of practice even if they have sensitive ears, which is because their minds can understand the music and know what sound they want, but due to decreasing proprioception, their playing apparatus cannot obtain feedback from keys sensitively.

A study shows that the velocity in discriminating real and illusory hand movements decreases with age, and verifies that the declination of kinesthetics perceptions relates to muscle proprioception more than touch (Landelle, Ahmadi, & Kayounoudias, 2018). This requires players to possess spatial awareness when playing the piano, because techniques such as large leaps and rapid passages require hands and fingers to pick up and move quickly over the keys; without good spatial awareness, the player would play wrong notes frequently. Additionally, the wrong notes probably also relate to another factor. In the musculoskeletal system, various elements of the proprioceptive system decline with age, therefore, it perhaps causes frequent accidents and motor control

problems (Kröger & Watkins, 2021). Moreover, the relationship between posture and proprioception shows that adolescents cannot achieve a posture as perfect as adults because the mechanisms related to postural control are still maturing during adolescence, which influences the information that proprioceptors integrate with postural control (Viel, Vaugoyeau, & Assaiante, 2009).

Moreover, there is a kind of proprioceptor – muscle spindles – distributed in the muscles. It is a unique sensory receptor that contributes to proprioception, posture and movement control, motor learning, and the plasticity of motor behaviours (Österland, Liu, Thornell, & Eriksson, 2011). This sensor is composed of muscle fibres. Matthews explained that when external forces pull muscles or muscles contract spontaneously, the length of intrafusal muscle fibre will change and then stimulate the sensory nerve endings of intrafusal muscle fibre to trigger impulses and transmit them to the nerve centre to generate proprioception. Muscle spindles are usually distributed all over the body, but there are more in limbs, especially hand and foot muscles. These muscle spindles help muscles measure stretch and remind the brain to issue protection commands when muscles are overstretched. Moreover, muscle spindles not only sense the length of the muscles but also sense their velocity. (Matthews, 2015) Development lasts from the embryonic stage until adulthood (Kröger & Watkins, 2021), and due to the neurophysiological factors underlying proprioceptive development and the neuro changes influencing muscle spindles, precision in sensing muscle position and random errors decline with increasing age (Holst-

Wolf, Yeh, & Konczak, 2016). Therefore, proprioceptive development affecting postural precision is still active during adolescence.

From the above, we can surmise that late beginners can enhance proprioception through systematic and scientific physical exercise, and it is doubtless to say that finger physical exercise is necessary for adolescent beginners. Therefore, I will introduce four kinds of equipment used during the 19th century and recommend the finger exercise of Mikimoto during Chapters IV and V, then provide scientific and natural physical finger exercise to improve the finger function of adolescent beginners. Hand stiffness is related to the tendon or ligament and associated with motor and musculoskeletal systems. Physical exercise can help adolescent beginners improve softness of touch and enhance the flexibility of locomotor organs used for playing. Simultaneously, we can use more metaphorical and image-based ways to explain music, leaving them space to understand music in a more personal way. Indeed, there are plenty of past methods and pedagogies that had guided beginners start from music theories, and I think those methods have realised that understanding music at first is important for playing instruments. Thus, studying psychological development in adolescence has become a vital link for my research. I will introduce several typical psychological characteristics of adolescents in the next part that inform the mental aspect of my methods.

2.6 Psychological Characteristics

In adolescence, significant mental, intellectual, and cognitive changes occur. One development is that adolescents can understand more things from their circumstances to increase various abilities or skills and influence their choices; one is their psychological changes when facing risks. Among those different abilities, adolescents develop abstract thinking, the ability to consider things from various perspectives, and the ability to reflect on the process of thinking (Mills & Anandakumar, 2020). It is important to imagine music and understand music theory before learning instruments. A good comprehension brings good musicality; a good musicality help fingers to play fluently.

Simultaneously, emotional sensitivity factors into the cognitive development of adolescents. Positive emotions benefit adolescents by staving off depression (Zhao, Yu, Wu, Zeng, & Peng, 2019). Moreover, there is a tendency among east Asian adolescents to like living with positive and negative emotions, and their emotional expression is more demonstrative than Euro-American adolescents (Miyamoto & Ryff, 2011). There is a saying in Chinese family education: “Children should grow up with encouragement; praise can stimulate students’ learning motivation”. Nevertheless, everything has two sides. The different growth environments and individual variations may cause a complacency effect for some students. Therefore, instructors should avoid overcomplimenting adolescent students.

Conversely, negative emotions have a detrimental effect. According to Zhang, adolescents easily suffer social anxiety and stress. On the one side, when they obtain negative evaluations from society it will produce high anxiety; on the other side, substantial conformity causes lower self-esteem and brings more social anxieties to adolescents. (Zhang, Deng, Yu, Zhao, & Liu, 2016)

Conformity is a kind of behaviour that entails following beliefs, attitudes, and norms prevalent in society. It is usually motivated by fear of social exclusion. Similarly, vanity is a kind of psychology express form to gain honour on the surface and arouse widespread concern from surroundings. These two psychologies are apparent in different personal behaviours among art students. It is a beneficial form of conformity to compete with each other and shorten the learning progress. However, conformity has the terrible side, which tends to vanity, express himself, or pursue too much in material aspects.

Avoiding bad conformity and vanity in adolescent students is the essential mental task; if they are formed, stress and anxiety will be more substantial and negatively affect adolescents' practice and behaviour. Musical works that are too difficult to practice easily lead to negative emotion and make students practice inefficiently, and even causes students to lose self-confidence and give up. Therefore, it is necessary to set an appropriate goal and choose music reasonably suited to the technical level of adolescent beginners.

Most of adolescents are sensitive to feedback, especially middle-high school

students (Matsumoto & Yamashita, 2020). Therefore, instructors should grasp this reality, make a learning schedule according to the physiological characteristics of adolescents, encourage adolescent students to practice and study piano methodically, and simultaneously avoid “plucking up a crop to help it grow” by refraining from unnecessary negative evaluations.

According to Kodama, Ishikuma, and Toyama, when junior high school students face stresses and anxieties mentioned above, such as negative evaluations, their behaviours are more optimistic than senior high school students. Besides negative evaluations, to some degree school examinations are a challenging topic for students. Though examinations cause much anxiety in senior high school students, they also promote their learning progress. (Kodama, Ishikuma, & Toyama, 2017) I mentioned in Chapter I that many piano students are preparing for the conservatory of music entrance examination, and I believe they must be anxious. Kodama’s research has provided us with the revelation that instructors must help adolescent piano learners tackle difficulties such as performance techniques, score reading or memorization, and lead them to truly recognise the purpose of examinations and help them make a scientific learning programme.

The relationship between instructors, parents, and adolescents is important. This relationship impacts adolescents’ life in different dimensions. In China, many students in grade one or two of senior high school have decided whether to

take the art college entrance examination according to their academic performance. These students usually participate in the art college entrance examination after one or two years of intensive training. Their goals are clear, and most of their motivation comes from the pressure of the college entrance examination. Moreover, some senior high school students prepare to participate in the special examinations of comprehensive universities because those universities will give them preferential admission standards in the entrance examination. Mills and Anandakumar have given two suggestions for instructors and families to guide those students who have definite purposes. First, guiding them to make choices by themselves and allowing them free space is necessary for adolescent life. Second, it is vital to give them an optimistic environment. (Anandakumar, 2020) On the one hand, both two suggestions are conducive to relieving social anxiety and stress. On the other hand, in piano learning, when adolescents can play some mid-level pieces, teachers can provide several pieces as options. Also, in the course instruction, the enjoyable feeling of learning music should be conveyed.

Relationships cannot be unilateral but must allow interactional influences. Adolescents cannot deal with an inharmonious relationship with their parents unless they improve their ability of self-control (Liu, Wang, & Tian, 2019). Self-control is a habit that needs to be cultivated in adolescence. It helps people regulate their behaviour to achieve higher goals. Adolescent students who want to participate in the art college entrance examination will inevitably be under the

pressure of learning and practice, and this makes it difficult to resist the temptation of diversions and relaxation available in their environment. At this time, self-control will play an important role.

The interactional influences between parents and adolescents play an important role in adolescent students' life. Life satisfaction and adolescents' academic achievement is undoubtedly interconnected (Atikulac, Bos, Foulkes, Crone, & Hoorn, 2019). It is a kind of satisfaction that comes from gaining approval or rewards from the surrounding environment, which the adolescents prefer, and this state will continue into young adulthood. However, adolescents' academic achievement is associated with parents' education, particularly on the mother's side (Crede, Wirthwein, McElvany, & Steinmayr, 2015). Support from parents plays an important role, and adolescents rely on it heavily. Dutton shows that Chinese adolescents are more reliant on informational and emotional support from their parents, while other countries' adolescents represented less reliance. Moreover, distress is impacted by informational supports among American adolescents while other Asian adolescents show a lower influence. (Dutton, Choi, & Choi, 2020) This proves that the ability to communicate with students' parents is necessary for an instructor.

Finally, I want to supplement with one more psychological viewpoint. We have examined development from early childhood to adolescence and seen how psychological and emotional changes will be affected by both internal and

external factors. Especially for those adolescent beginners who will participate in art training, there are more psychological changes and problems related to the outside world. If students cannot acquire good psychological counselling at this stage, or the teacher cannot assist their psychological problems correctly and in a timely manner, those students who have the dream to be a teacher will not be able to resolve their psychological problems. After they become teachers, they will likewise be unable to provide effective guidance regarding the psychological problems of their own students, resulting in a vicious cycle in education.

Chapter III: Practical Surveys on Piano Learners and Instructors

In the previous chapter, we saw the physiological and several psychological characteristics of adolescents. As a practical experiment, I conducted questionnaire research for students during 2018, 2019, and for instructors in 2020 to learn the specific situation of adolescent beginners, such as specifics about the techniques that students felt are difficult, the maximum interval their hand can span, and the daily practice time. Furthermore, the research investigated problems encountered by teachers when they were teaching adolescent beginners. In addition to the questionnaires, I also interviewed several adolescent beginners after I audited their lessons. These results⁵ will provide the actual evidence and help the study and implementation of better piano methods. In addition, all tables and graphs are made by the author in this chapter.

3.1 On Piano learners

3.1.1 2018 Questionnaire

In 2018, I surveyed 194 Japanese music university students, which all come

⁵ Some results of this chapters by using percentage to do the statistics. In statistics, giving meaning to data is to use percentage description; the percentage represents the change value relative to other things. I used percentage for statistical analysis in this survey because there are few samples in some groups, and comparison between groups is required.

from Elisabeth University of Music. It includes 117 piano minor and 43 piano major students, and other 34 students are not piano major or minor but have studied the piano for several years. The questionnaire included the following questions (Among them, questions (3) and (4) are open-ended questions.):

- (1) Personal details (major, grade, age, gender, the starting age of piano learning).
- (2) What interval can you reach (interval span)?
- (3) The difficult techniques that you meet when practising the piano.
- (4) The techniques that cannot be conquered after lots of practice.
- (5) Daily piano practice time.
- (6) How much pain and fun do you feel during practice?

The results of the question (1) are shown in *Table 3.1*, and the respondents include all undergraduate students who are learning piano from grades one to four. In addition, there are 3 piano minor females did not answer when do they started the piano learning. Their ages are shown in *Table 3.1*.

Table 3.1

Number of respondents

		After age ten	Before age ten
Piano Major	Male	1	2
	Female	1	39
Piano Minor	Male	19	9
	Female	20	66

Note: The table shows 157 respondents who are piano major and minor students. (3 piano minor female respondents did not answer their piano starting time.)

Table 3.1 reveals that there are more piano minor students than piano majors, and there are more students who began piano learning before age ten than after age ten. However, there is a lack of statistical significance about the data of the piano major students who started piano learning after age ten because the small samples.

Table 3.2

The age of respondents

Age Gender	18	19	20	21	22	23	25	54	70
Female	31	30	37	44	7	2	1	1	1
Male	6	16	4	6	3	1	0	0	0

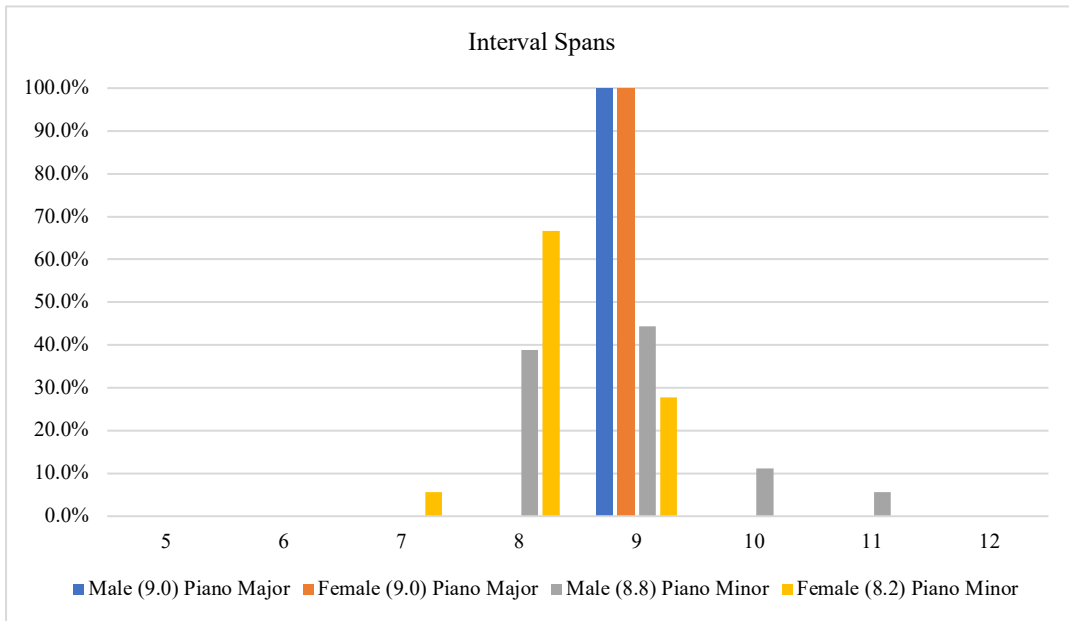
Note: 4 students did not answer this question.

Table 3.2. shows that almost all students are between 18 and 22 years old, but there is one female student who is 54 years old and one female student who is 70 years old. No male students are over 25 years old.

The following graphs show the result of question (2): the intervals that can be reached by students who began piano study after and before age ten. In the graphs, the numbers in parenthesis show the average of interval spans. The respondents who began learning piano after age ten include 1 male piano major and 1 female, 18 piano minor males and 18 piano minor females answered, and 1 male and 2 female piano minors did not answer it. The respondents who began the learning piano before age ten include 2 male and 39 female piano majors, and 9 male and 64 female piano minors, 2 piano minor females did not answer it.

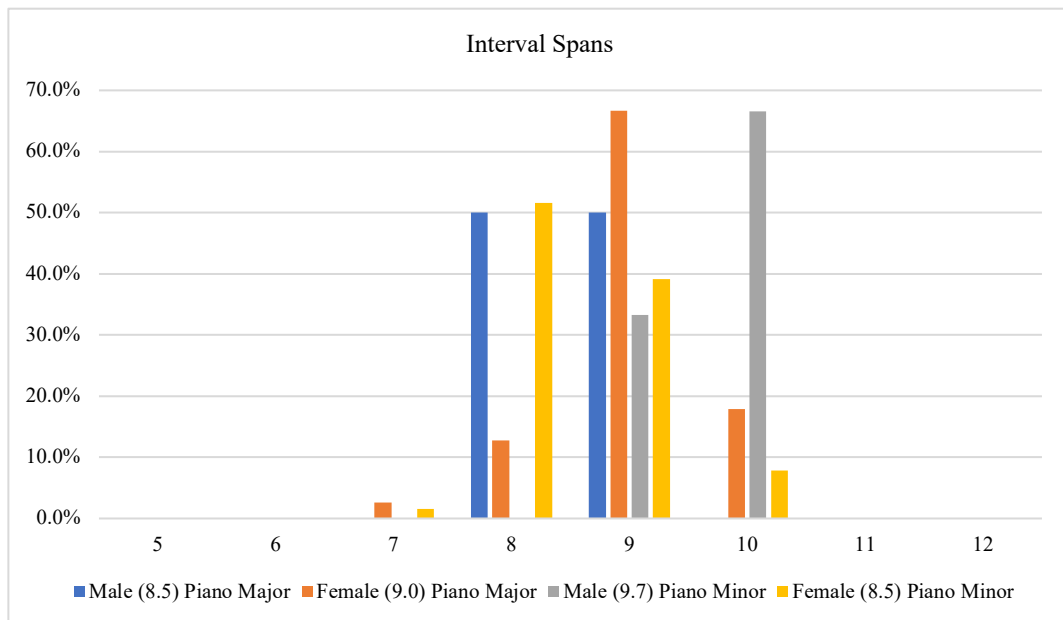
Graph 3.1

Interval Spans (the respondents who began study after age ten)



Graph 3.2

Interval Spans (the respondents who began to study before age ten)



As indicated in the graphs, it is revealed that piano minors who began piano study before age ten can reach larger intervals than those who began after age

ten. It is possible that, since reasonable and proper exercise can promote increased bone mass and muscle maturation (Ruggeri & Baroncelli, 2006) (Manna, 2014), the hands of students who have been trained since childhood could be more stretched than those who started late. Furthermore, because the ligaments and tendons are still soft and under maturation in childhood, they can be stretched or shaped more under regular practice. However, this research lacks statistical significance due to the small sample size, and I will do the supplemental analysis in the next year's questionnaire survey to find more evidence.

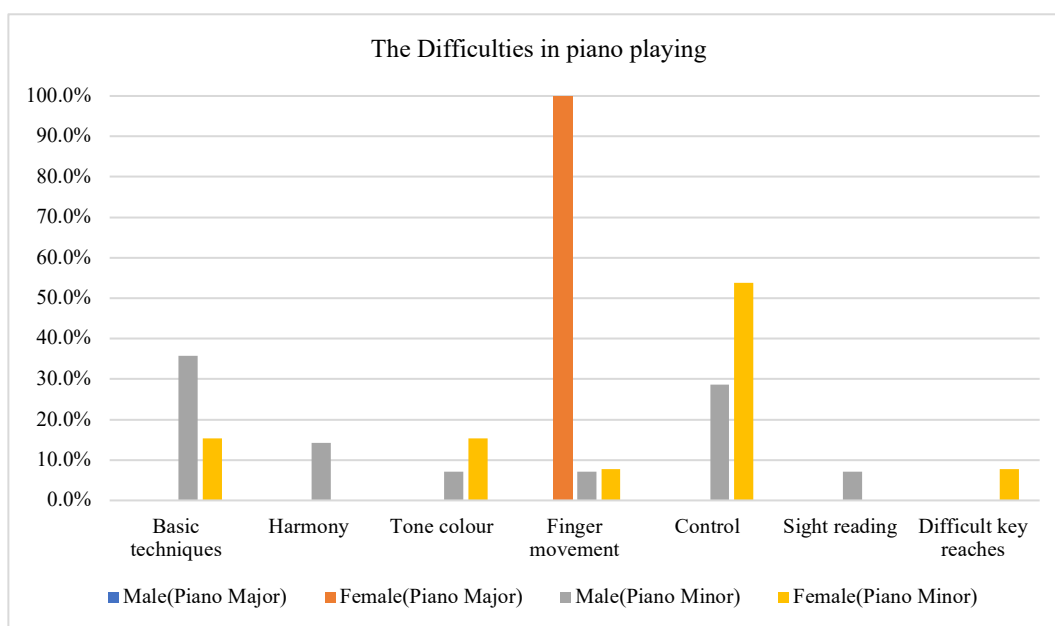
By using the KJ method (Affinity Diagram), I analysed the students' answers about the questions (3) and (4), and finally got seven categories: basic techniques, harmony, tone colour, finger movement, control, sight-reading, and difficult key reaches. The basic techniques include arpeggios, scales, trills, octaves, ornaments, skips, staccato, and pedalling; finger movement includes fast movement, fingering, keystroke, rhythm, touch, and strength; control includes dynamics, balance, polyphony, timbre, and phrasing; sight-reading also includes memorisation. Then I executed data statistics by SPSS software.

The results are shown in *Graphs 3.3* (the students who started piano after age ten) and *3.4* (the students who started piano before age ten). Among the respondents of *Graph 3.3*, in the piano major group, five females answered, and one female did not answer; no male answered this part. In the piano minor group,

14 males answered and 5 did not answer, 13 females answered and 7 did not. In *Graph 3.4*, in the piano major group, 1 male and 39 females answered, and 1 male did not answer. In the piano minor group, 3 males and 62 females answered, and 6 males and 4 females did not answer. In this survey, there are few piano major students who started piano learning after age ten, hence this part is not in the scope of analysis.

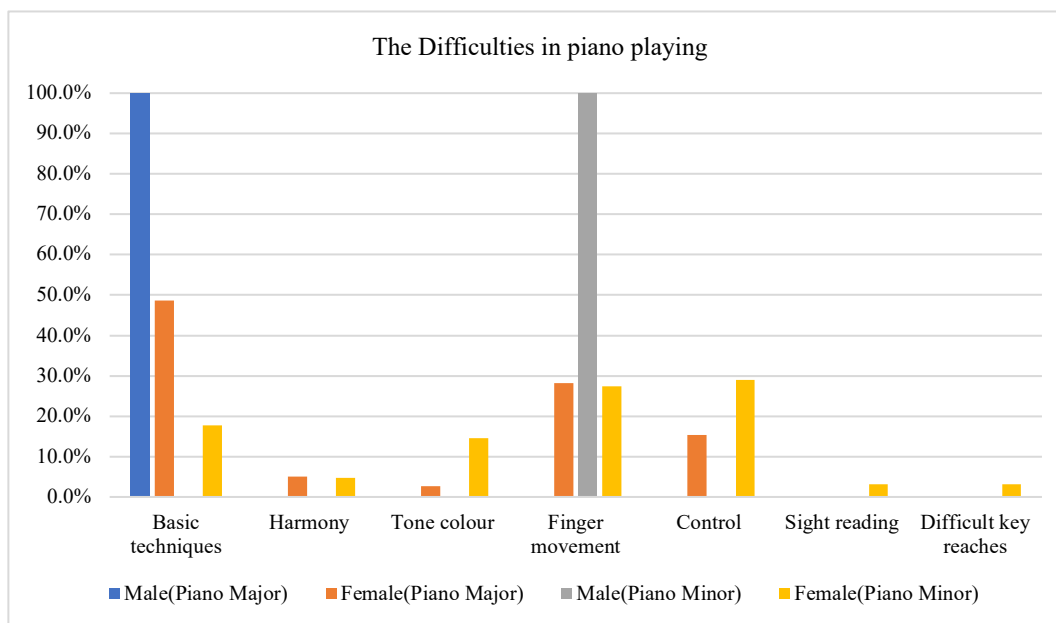
Graph 3.3

The difficulties in piano playing (the respondents who began study after age ten)



Graph 3.4

The difficulties in piano playing (the respondents who began to study before age ten)



A comparison of *Graph 3.3* and *3.4* reveal that in the piano minor group, most female students who began piano study before age ten think the difficulties are “finger movement” and “control”; in the piano major group, most of the female students think the difficulty is “basic technique”. On the other hand, because there are only 2 piano major students who began piano study after age ten answered the question, the sample size is too small, so it is without statistical significance. Furthermore, most male students who started piano after age ten in the piano minor group think the difficulties are “basic technique” and “control”, while most female students only think “control” is difficult. Also, three male students answered the question, and they think that “finger movement” is problematic.

The students who began piano study after age ten pay more attention to music but less to fingers. However, among the students who began piano study before age ten, their attention is mostly focused on finger movement and basic technique, except the piano minor female students, while a part of them also think “control” is difficult. This result suggests that piano major student is more proficient in finger control and pursue perfect touch and music performance techniques. According to the physiological characteristics of adolescents and my perspectives, the reason why piano minor students are poor touch proficiency is lack of their piano practising time, which is to say, the unconditional reflex between fingers and keys has not been established yet. Additionally, it also implies there is an influence brought by gender difference.

The following table reveals the average result of question (5), concerning daily practice time. Almost all participants answered this question, except two female piano minor students who began piano study after age ten, one male piano minor, and one female student who began piano study before age ten. Because there were only two participants in the category of piano major students who began piano study after age ten, this part was not considered during analysis.

Table 3.3

Average daily practice time

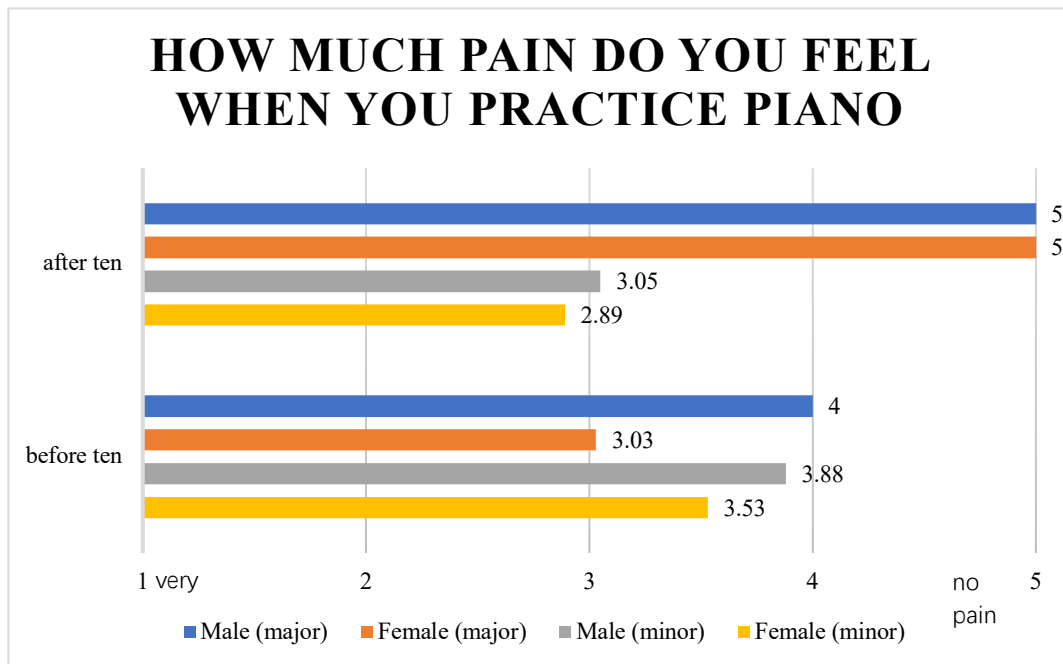
		After age ten	Before age ten
Piano Major	Male	120.00 min	225.00 min
	Female	240.00 min	170.77 min
Piano Minor	Male	43.42 min	52.50 min
	Female	48.61 min	53.23 min

From *Table 3.3* we can easily find that the students who began piano study before ten years old usually practice more than students who began after age ten. It may be because the students who began piano study after ten years old lack long-term training and did not cultivate the hobby of piano playing since childhood; thus, piano practice is just dull.

The following graphs show the result of question (6). Almost all participants answered the question, except for 1 female piano minor student who began piano study before age ten.

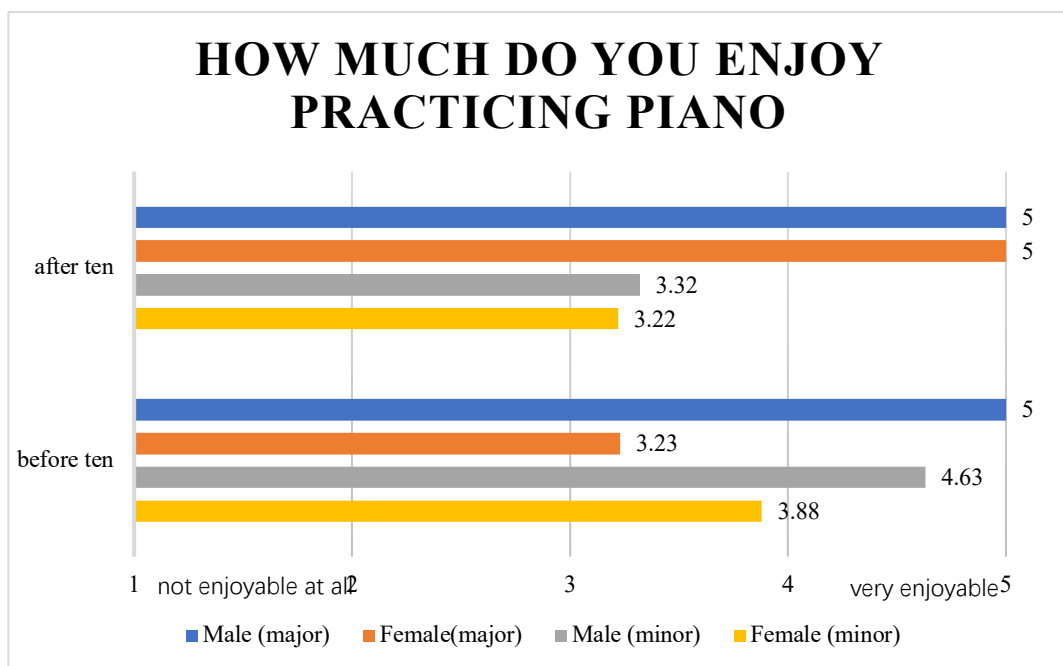
Graph 3.5

How much pain do you feel when you practice the piano



Graph 3.6

How much do you enjoy practising the piano



We can break down the results shown in these two graphs. Because there are few samples of piano major students, those results can be not analysed. From the graphs, students who began to study piano after age ten feel more pain than students who began before age ten. Additionally, students who began study before age ten feel more enjoyment than students who began after age ten. Consequently, students who began studying after age ten are easy to feel frustrating and unenjoyable when practising the piano. There are probably many reasons for this psychological result. Such as I mentioned in Chapter I, these adolescent beginners have a strong purpose in their study. In addition, the temptation of the surrounding environment may make their practice seem like a chore. This suggests instructors need to notice the psychological aspects of adolescent beginners.

The survey in 2018 has shed some light on the current situation of students who began piano learning after age ten. However, due to the small number of samples, a second survey was conducted in 2019 to increase the sample size and gain more accurate results.

3.1.2 2019 Questionnaire

During the survey in 2019, all participants were from Chinese schools, including Sichuan Conservatory of Music, Sichuan Normal University College of Music, Changchun Humanities and Science College – the College of Arts, and

other students from the training schools for the college entrance examination of art. Among them, most students were 1) piano minor undergraduate students; 2) preparing for art college entrance examinations; 3) just started piano learning one to three years ago. Therefore, this survey will provide a reliable basis for the research.

Regarding the questionnaire contents, almost all questions are consistent with those of 2018, but one question's form was changed. In the 2018 questionnaire, question 4 concerning the difficulties students felt while practising the piano was classified into 17 items by the KJ method (Affinity Diagram). The items included "scales", "arpeggios", "tremolos", "octaves", "trills", "using the 3rd, 4th, and 5th fingers", "difficult key reaches", "different movement in two hands", "body balance", "chords", "keeping tempo", "dynamic control", "tone colour", "pedalling", "reading many key signatures", "memorising scores", and "fast finger movement". These 17 items were used in question (3) in 2019 but were organised in a multiple-choice format unlike the open-ended question in 2018. The following six questions are involved in this questionnaire:

- (1) Personal details (major, grade, age, gender, the starting age of piano learning).
- (2) What interval can you reach (interval span)?
- (3) The difficult techniques that you encounter when practising the piano.
- (4) Daily piano practice time.
- (5) How much pain and fun do you feel during practice?

The participants were divided into four groups: piano majors, piano minors, those who began piano study after age ten, and those who began piano study before age ten. In each group, respondents are classified by sex. There were 481 respondents, including 420 university students and graduated students, 60 senior high school students, and 1 respondent is unknown. Among 420 university students and graduated students, 215 respondents answered their majors: there are 17 male and 37 female piano majors, and 27 male and 71 female piano minors who started piano learning after age ten. Furthermore, there are 5 male and 39 female piano majors, and 7 male and 12 female piano minors who started piano learning before age ten.

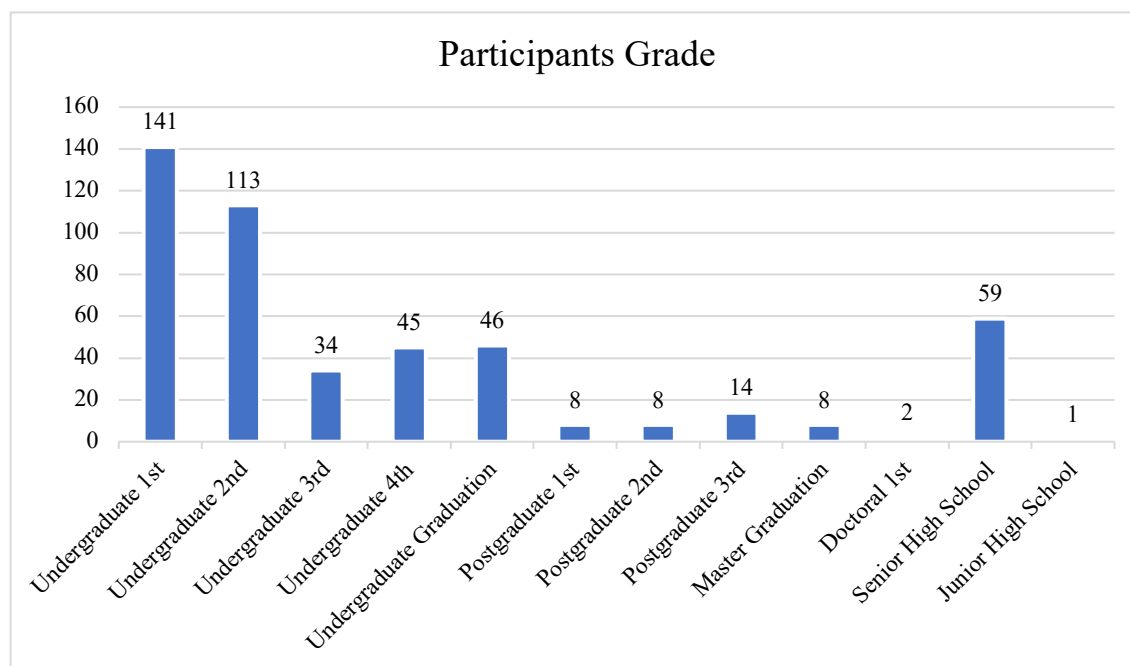
The following analysis is divided into two parts, the objects all come from the 481 respondents. Analysis (1) take the 215 respondents who answered their majors; Analysis (2) extract 348 respondents who are piano minor and high school students, and the respondents who did not answer their majors.

Analysis (1):

First, the result of the participants' grades is as follows:

Graph 3.7

Participants' Grades

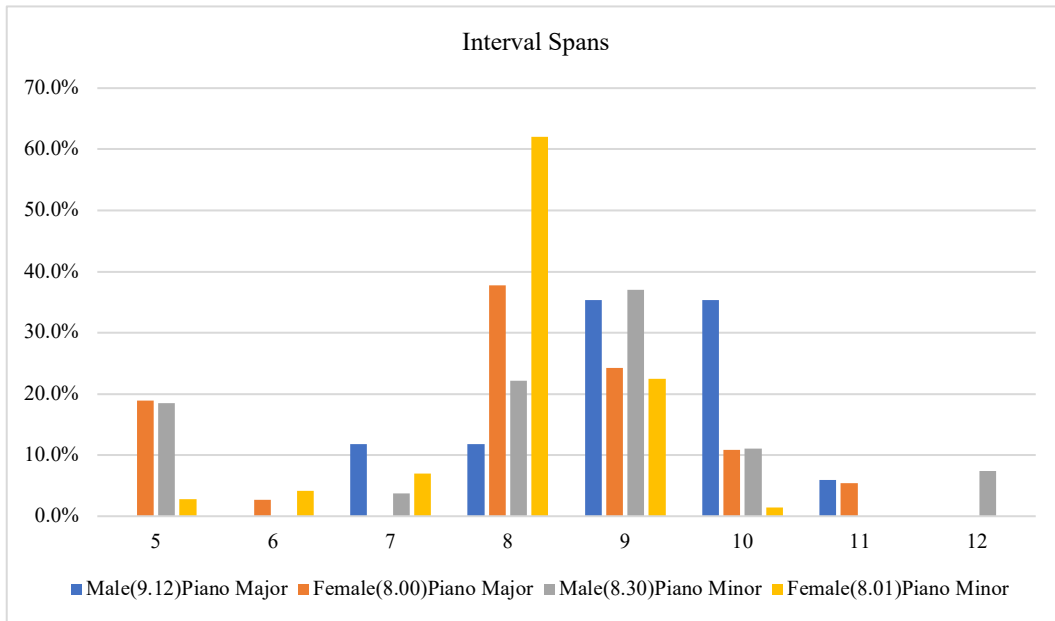


The graph shows that most of the respondents come from the first and second grades of college. There are some high school students who are preparing for the art college entrance examination in art training institutions.

Graphs 3.8 and 3.9 show the results of question (2) (What interval can you reach (interval span)?), and the number in parenthesis at the foot of the graph shows the average interval spans.

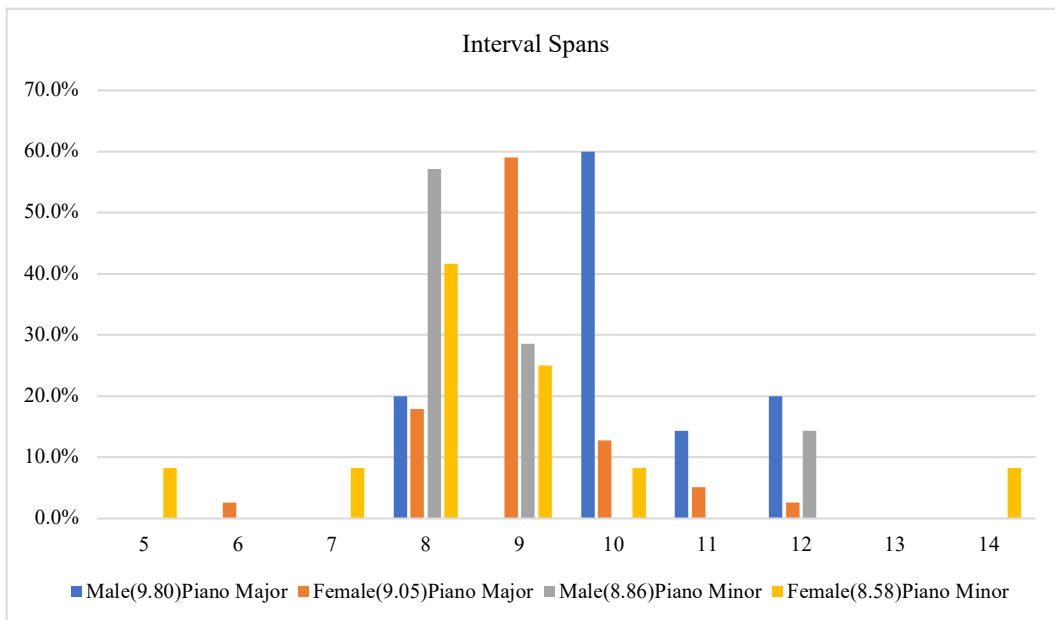
Graph 3.8

Interval spans (the respondents who began study after age ten)



Graph 3.9

Interval spans (the respondents who began to study before age ten)



The results show that the male piano majors can reach larger intervals than male piano minors, and the same result was observed among the female students.

Several students can only reach intervals shorter than a 7th, which is a problem when playing the piano. Moreover, several male respondents who began piano study after age ten chose intervals shorter than an octave, which is also a big problem when playing the piano. There are two influences to be considered. One is a gender difference; females are usually born with small hands, but males' are usually bigger. Another is the starting age of piano study. Early beginners have higher body plasticity, thus systematic training can influence their physiological development. However, because the body plasticity of adolescent beginners declines, even if they are trained for the same time span as the early beginners, their change on the physiological level is still negligible. Therefore, adolescent beginners need to adopt a more efficient and scientific piano practice method, such as finger exercises.

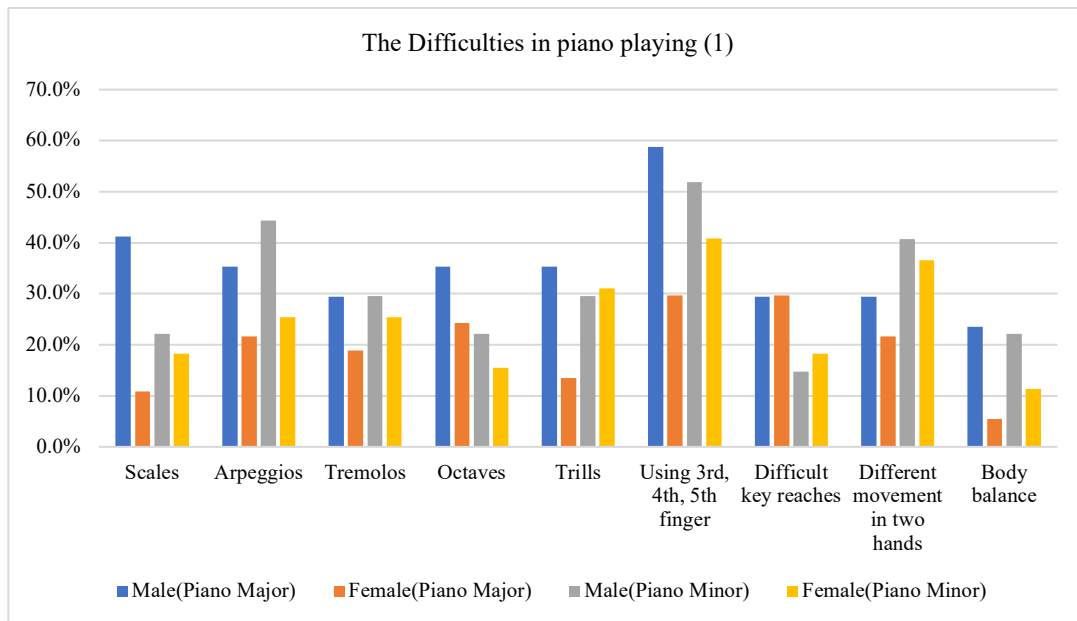
Compared to *Graph 3.8* and *3.9*, almost all respondents who began piano study after age ten can reach intervals over an octave. More early-beginner male piano majors can reach intervals over an octave, especially 10ths, than male piano majors who began piano study after age ten. This shows that hand softness and flexibility are challenges for late beginners. During childhood, humans have a soft and immature skeleton, tendons, ligaments, muscles, and nerves. The development of these body systems is influenced by external factors. However, the epiphysis in human finger joints is ossified at the end of puberty. In physiological terms, we call it the epiphyseal fusion of the phalanges, which means hands are no longer soft and flexible like in childhood, and it becomes a

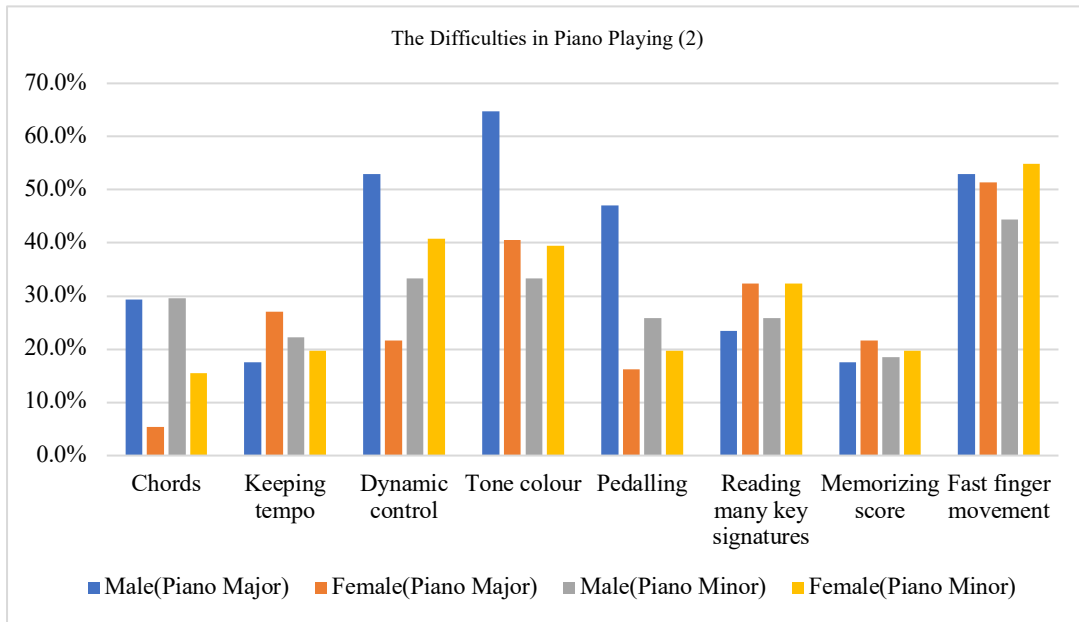
big problem for piano practice. This physiological principle can be used to explain the survey results.

Graph 3.10 and *Graph 3.11* show the result of question (3) concerning the difficult techniques encountered when practising the piano. All of the participants answered this question. The graphs are divided into two groups according to the starting age of learning piano for comparative analysis.

Graph 3.10

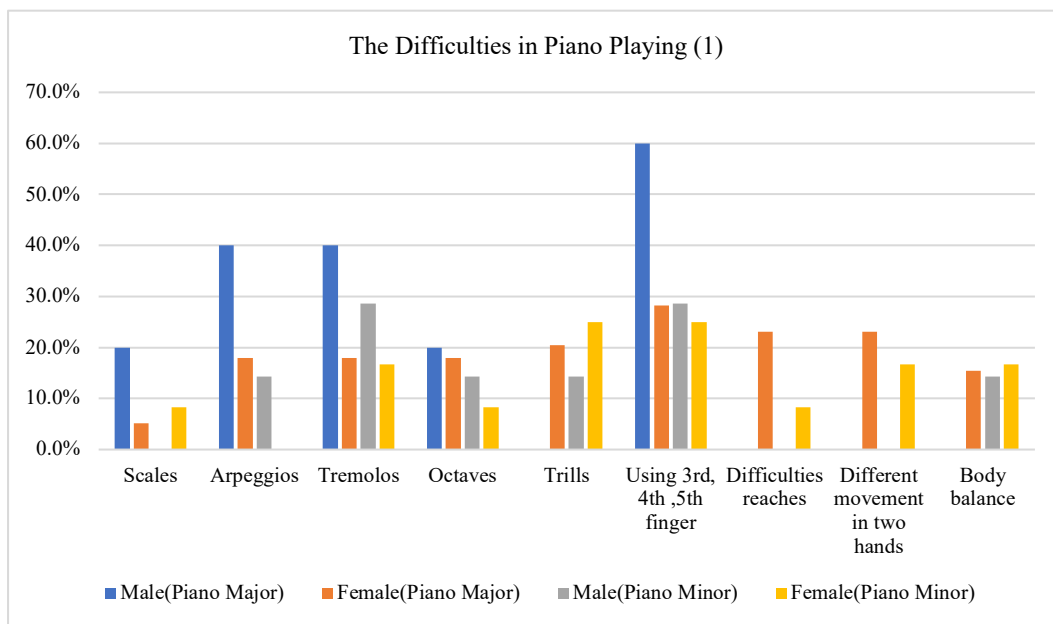
The difficulties in piano playing (The respondents who began study after ten)

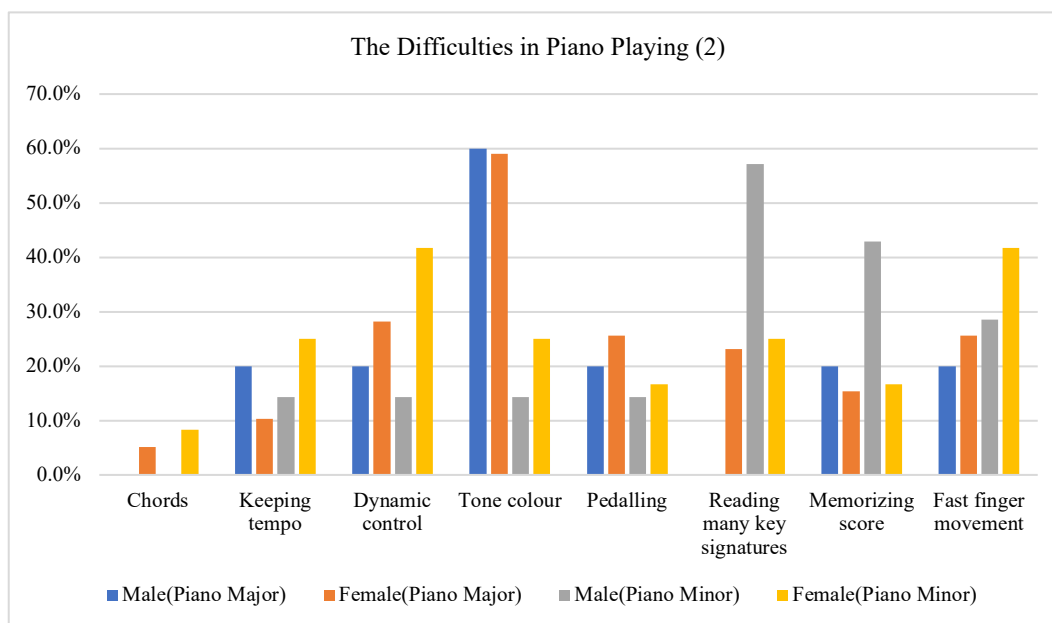




Graph 3.11

The difficulties in piano playing (the respondents who began to study before age ten)





As can be seen from *Graph 3.10*, over 50% of male piano majors chose the options of “using the 3rd, 4th, and 5th finger”, “dynamic control”, “tone colour” and “fast finger movement”. Over 50% of female piano majors chose “fast finger movement”. Regarding the options of basic techniques like “scales”, “arpeggios”, “tremolos”, “octaves”, “different movements in two hands”, “body balance”, “chords”, and “pedalling”, more male students than female students chose them. Among piano minors, over 50% of male students chose “using the 3rd, 4th, and 5th finger”, and over 40% of males chose “arpeggios”, “different movement in two hands” and “fast finger movement”. Over 50% of female students chose “Fast finger movement”, and over 40% of female students chose “using the 3rd, 4th, and 5th finger” and “dynamic control”.

On the other hand, *Graph 3.11* shows the results of the piano students who started piano learning before age ten. We can find a similar result to the last

graph. There are more male than female students who chose “scales”, “arpeggios”, “tremolos”, and “octaves”. Among the piano majors over 50% of male students chose “using the 3rd, 4th and 5th finger” and “tone colour”; over 50% of female students chose “tone colour”. Moreover, over 40% of male students chose “arpeggios” and “tremolos”. Among piano minors, over 50% of male students chose “reading many key signatures”, while over 40% of female students chose “dynamics” and “fast finger movement”. Additionally, over 40% of male students chose “memorising scores”, and over 40% of female students chose “dynamic control” and “fast finger movement”.

The results from Graphs 3.10 and 3.11 reveal that 1) gender difference is indeed a factor in piano playing, especially in the techniques related to finger use; 2) systematic and long-term practice can influence change on a physiological level; 3) piano major students are aware of the tone colour and dynamic elements related to piano sounds and music. I suspect this is not merely the result of having begun to study early in life, but also of having had long-term professional training, which has improved the sensitivity of their ears and fingers. Therefore, they concentrate more on the sounds than other objects; 4) fewer students who began piano study before age ten chose items about basic techniques than those who began after age ten. Therefore, this could indicate that learning piano for a more extended time and starting at an early age will make it easier to get over the difficulties of basic techniques; 5) the students who chose “using the 3rd, 4th, and 5th finger” suggests that this problem is closely related to physiological

factors, because whatever the starting age, this problem widely exists among the male students. Therefore, the experiments comparing same-age male and female pianists and non-pianists are suggested in future research. 6) due to long-term practice, whatever the piano starting age, the flexibility of the motor organs and the hand's extensiveness can be improved. Also, finger sensitivity can be obtained; 7) starting piano study with music theory is feasible for late beginners because students who started piano learning after age ten chose theory-related items (reading many key signatures, memorising score) less than the students who started piano before age ten, it means they feel it is difficult. Furthermore, late beginners' cognitive competence contributes to higher understanding in this area.

Through the analysis of the above two graphs, I summarised the following table. Thus, we can see what is difficult for the students who started piano before or after ten; also, we can compare the similarities and differences between their choices. Finally, the results were analysed by the proportion of students who selected each item.

Table 3.4

The difficulties for piano students

		After age ten	Before age ten
Piano Major	Male	Using the 3rd, 4th, and 5th finger	
		Tone colour	
	Scale	Arpeggios Tremolos	
	Dynamic control Fast finger movement Pedalling		
Female	Tone colour		
	Fast finger movement		
Piano Minor	Male	Using the 3rd, 4th, and 5th finger	Reading many key signatures Memorising scores
		Arpeggios Fast finger movement Different movements in two hands	
	Female	Using the 3rd, 4th, and 5th finger	Dynamic control Fast finger movement
		Tone colour	

Note: The table shows the difficulties of piano major and minor students while practising the piano with different starting ages.

Table 3.4. leads us to the following conclusions: 1) The difficulties of “using the 3rd, 4th, and 5th finger” and “fast finger movement” are ubiquitous among all students; 2) The difficulty of “using the 3rd, 4th, and 5th finger” usually exists among the male students; 3) “Arpeggios” and “tremolos” are two difficulties chosen by most early-beginner male piano majors, and “arpeggios” is selected by a high proportion of late-beginner male piano minors; 4) Students who started learning piano after age ten face more difficulties than those who started before age ten. Therefore, gender and starting age profoundly influence students’ physiological changes, and these changes lead the body to adapt to the various movements and actions in piano playing. In other words, the necessity of external conditions and internal changes of the body are mutually restricted.

The table below shows the average result of question (4) concerning daily practice time. Among the 152 respondents who began studying piano after ten, 17 male and 36 female piano major students answered the question while 1 female student did not; 27 male and 68 female piano minor students answered while 3 female students did not. Among the 63 respondents who began piano study before ten, 5 male and 36 female piano major students answered the question while 3 female students did not; all 7 male and 11 female piano minor students answered while 1 female student did not.

Table 3.5

Average daily practice time

		After age ten	Before age ten
Piano Major	Male	180.59 min	174.00 min
	Female	122.22 min	143.39 min
Piano Minor	Male	80.37 min	90.00 min
	Female	85.69 min	89.55 min

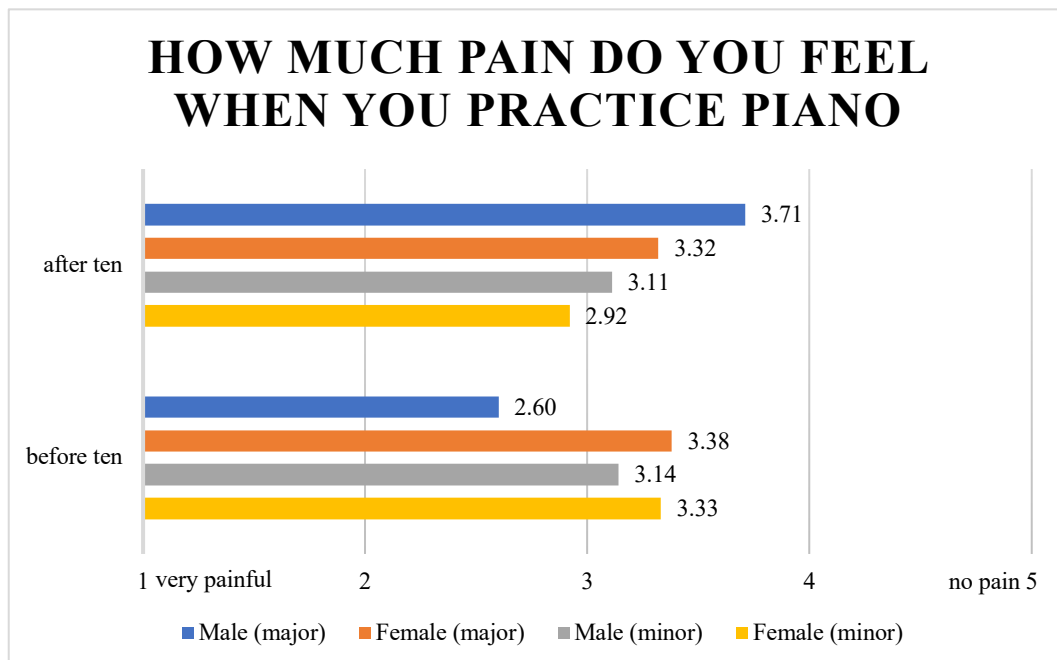
Table 3.5 shows the average daily practice time of participants. Obviously, the piano major students practice more than the piano minor students. Nevertheless, the piano minors who began piano study before age ten practise more than the student who began after age ten. The cause of this phenomenon could be related to the students' practice methods and how much fun they feel in practice. Moreover, piano minor late beginners usually recognise piano as a task during their school study. After all, piano is not their majors.

Besides the physiological effects, the emotion in practice also has an

influence on piano practice. The following graphs reveal the result of question (5). Regarding the survey, the respondents include the following: Among the piano major respondents, 5 male and 39 female respondents began piano study before ten years old; 17 male and 37 female respondents began the piano study after ten years old. Among the piano minor respondents, 7 male and 12 female respondents began piano study before ten years old; 27 male and 71 female respondents began piano study after ten years old. Respondents chose from degree one, very painful or not enjoyable at all, to degree five, no pain or very enjoyable, and degree three is standard. The results are averaged.

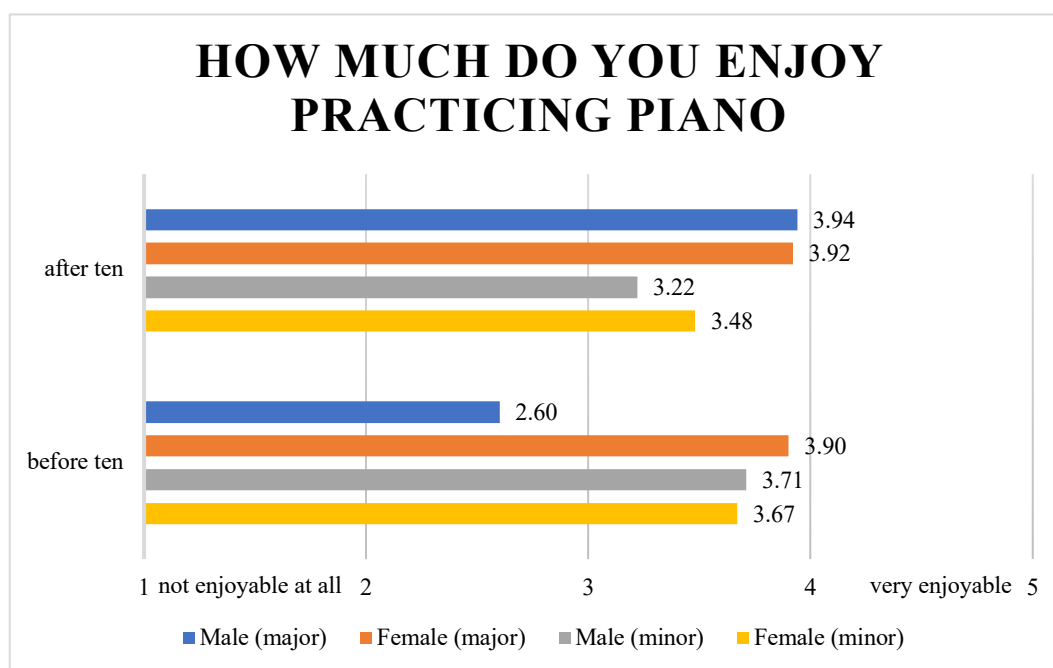
Graph 3.12

How much pain do you feel when you practice the piano



Graph 3.13

How much do you enjoy practising the piano



Concerning *Graph 3.12*, the survey’s question is “How much pain do you feel when practising the piano?”. We can see there are two groups that fall within the middle of the scale, and they are male piano majors who began piano study before ten years old (2.60) and female piano minors who began piano study after ten years old (2.92). Furthermore, the group closest to the “no pain” end of the scale is the male piano majors who began piano study after ten years old (3.71).

Regarding *Graph 3.13*, the question is “How much do you enjoy practising the piano?”. We can see there is only one group lower than the scale’s midpoint, which is male piano majors who began learning piano before ten years old (2.60). Moreover, three groups are the closest to the “very enjoyable” end of the scale.

They are male piano majors who began study after ten years old (3.94), female piano majors who began study after ten years old, (3.92) and female piano majors who began study before ten years old (3.90). Furthermore, male piano majors who started learning piano before age ten showed that they did not like practising the piano. Among the students who began to learn piano after ten years old, the piano majors felt practising is more enjoyable than the piano minors. This suggests to the teachers that it is necessary to cultivate students' interest in piano learning rather than just focusing on playing skills.

Moreover, it can be concluded by combining *Graph 3.12*, *Graph 3.13* and *Table 3.5* that most students who began learning piano before age ten are happier and enjoy practising piano more than those who began after age ten. Then, concerning whether the students' emotions or feelings during piano practice are related to the daily practice time, the following conclusions are obtained through the linear regression analysis, which reveals the interactions between emotions and daily practice time. The analysis includes 435 respondents, among them, there are 111 respondents who started piano learning before age ten, and 322 respondents who started piano learning after age ten.

Table 3.6

Stepwise multiple linear regression analysis of the students who start piano before age ten

Model Summary ^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.241 ^a	.058	.050	85.267
a. Predictors: (Constant), how much pain do you feel				
b. Dependent Variable: daily practice time				

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	49340.552	1	49340.552	6.786	.010 ^b
	Residual	799751.413	110	7270.467		
	Total	849091.964	111			
a. Dependent Variable: daily practice time						
b. Predictors: (Constant), how much pain do you feel						

Coefficients ^a						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	61.178	29.098		2.102	.038
	Painful	21.525	8.263	.241	2.605	.010
a. Dependent Variable: daily practice time						

A stepwise multiple linear regression was calculated to predict daily practice time based on how much enjoyment and pain the students felt during practice among the students who started piano playing before ten. A significant regression equation was found ($F(1,110) = 6.786, p < 0.05$), with an R^2 of 0.050. Even the feeling of pain was a significant predictor of daily practice time, but their relationship cannot be proved enough according to the analysis results.

Table 3.7

Stepwise multiple linear regression analysis of the students who start piano after age ten

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.335 ^a	.113	.110	75.506
2	.356 ^b	.126	.121	75.031

a. Predictors: (Constant), How much enjoyment do you feel?
b. Predictors: (Constant), How much enjoyment do you feel and how much pain do you feel?

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	232077.651	1	232077.651	40.707	.000 ^b
	Residual	1830062.40	321	5701.129		
	Total	2062140.06	322			
2	Regression	260660.675	2	130330.338	23.151	.000 ^c
	Residual	1801479.38	320	5629.623		
	Total	2062140.06	322			

a. Dependent Variable: daily practice time
b. Predictors: (Constant), How much enjoyment do you feel?
c. Predictors: (Constant), How much enjoyment do you feel and how much pain do you feel?

Coefficients ^a						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.887	16.182		.487	.626
	Enjoyable	28.449	4.459	.335	6.380	.000
2	(Constant)	-2.621	16.743		-.157	.876
	Enjoyable	20.113	5.772	.237	3.484	.001
	Painful	12.629	5.605	.153	2.253	.025

a. Dependent Variable: daily practice time

For students who started piano playing after ten, a stepwise multiple linear regression was calculated to predict daily practice time based on how enjoyable and painful the students found practicing. In the first step (Model 1), a significant regression equation was found ($F(1, 321) = 40.707, p < 0.001$), with an R^2 of

0.110. In the second step (Model 2), a significant regression equation was also found ($F(2, 320) = 23.151, p < 0.001$), with an R^2 of 0.121. The enjoyable and painful feelings were significant predictors of daily practice time, but enjoyable feelings are more significant than painful feelings.

It can be seen that for students who started learning piano before age ten, as long as they do not feel pain when practising, they will not resist practising the piano. Because the enjoyable felt during piano practice is not related to the piano practice time, the current research results show that even if the students feel enjoyment, the piano practice time may not increase. On the contrary, for students who started learning piano after age ten, if they do not feel pain, the more enjoyable they are, the more practice time. However, no matter what kind of students, the essential point in the study is enjoyment. Especially for adolescent beginners, students should use music itself to understand music, enjoy music, and thus experience the pleasure. This result laid the psychological foundation for my future pedagogy research.

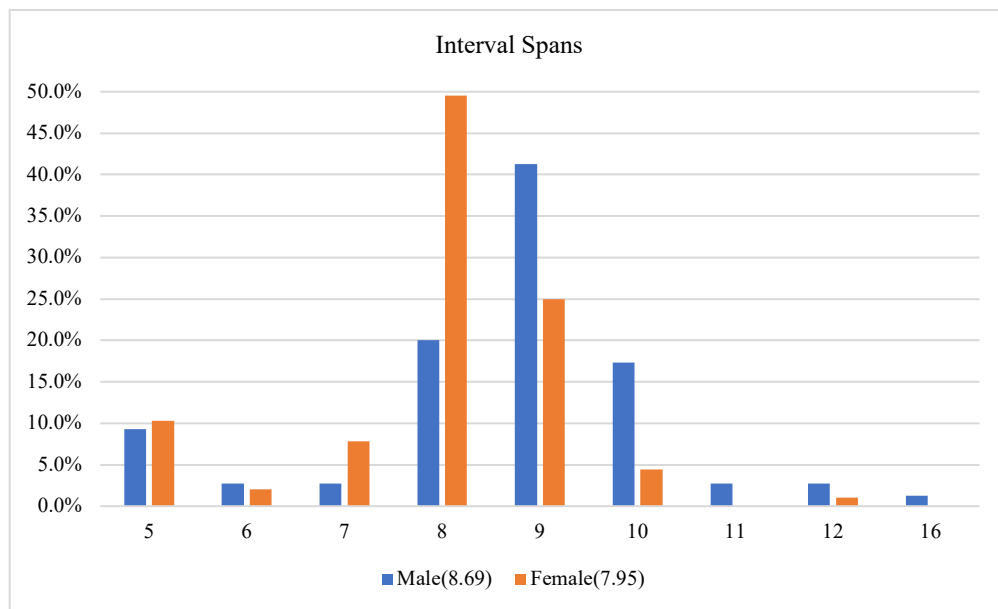
Analysis (2):

The statistics above are based on piano majors and minors with a university degree or above. After the analysis, we have acquired many results and evidence for my research. However, because the object in my research is adolescent beginners, and in order to extend the sample size to obtain more accurate results,

I aimed at and extracted the data of respondents who are not piano majors, which includes piano minors and high school students. Therefore, removing all piano majors, leaves 348 non-piano major college and high school students, among whom 69 began to learn piano before the age of ten (Male: 18; Female: 51), and 279 (Male: 75; Female: 204) began to learn piano after the age of ten. Thus, this group is like a control group. Because these students are not professionals, and most of them started late, the problems they reflected will provide a basis for lesson design in the early stage of teaching. Additionally, their results will be compared to the evidence from the previous analysis.

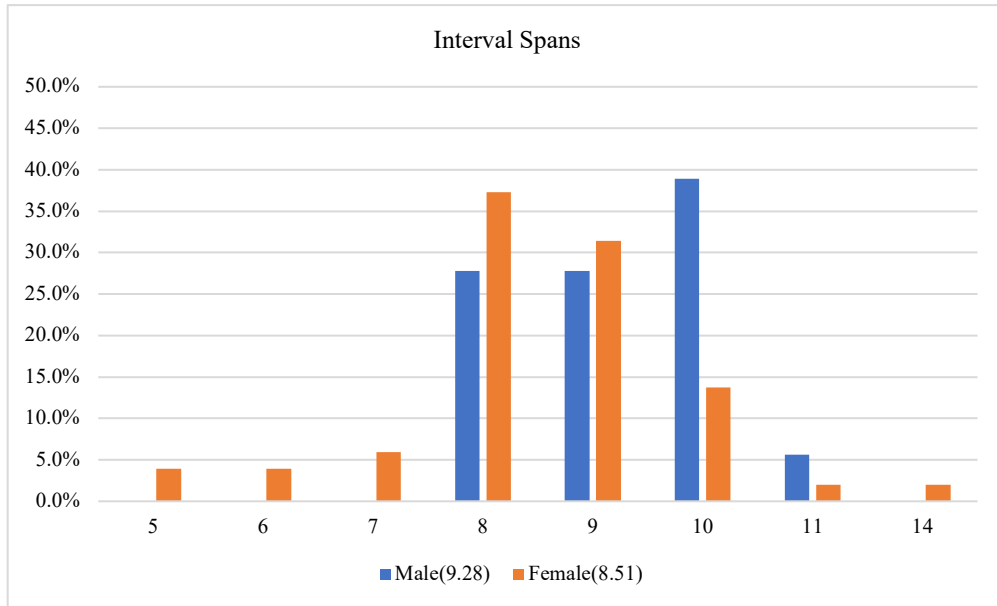
Graph 3.14

Interval spans (the respondents began studying after age ten)



Graph 3.15

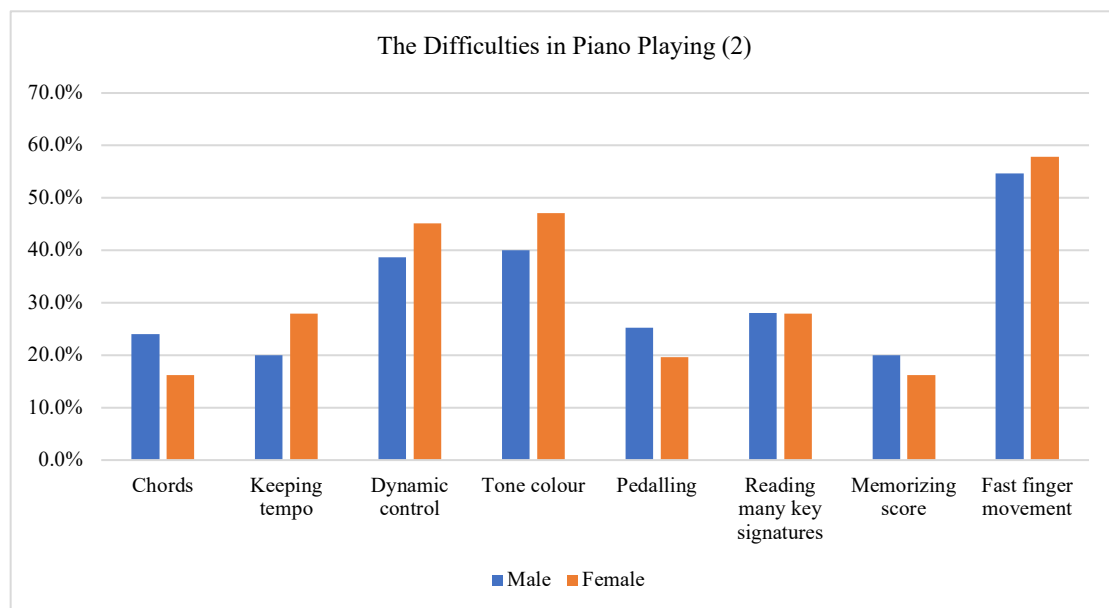
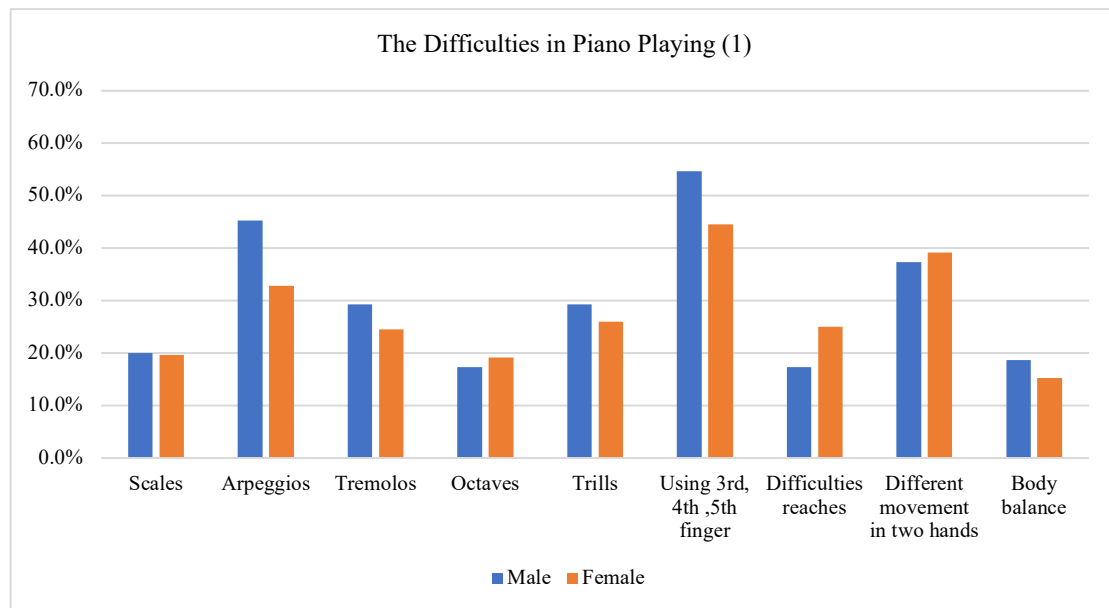
Interval spans (the respondents began studying before age ten)



From the two graphs above, the same results as with *Graph 3.8* and *3.9* can be obtained. Again, male students can reach larger intervals than female students, and early beginners can reach larger intervals than late beginners.

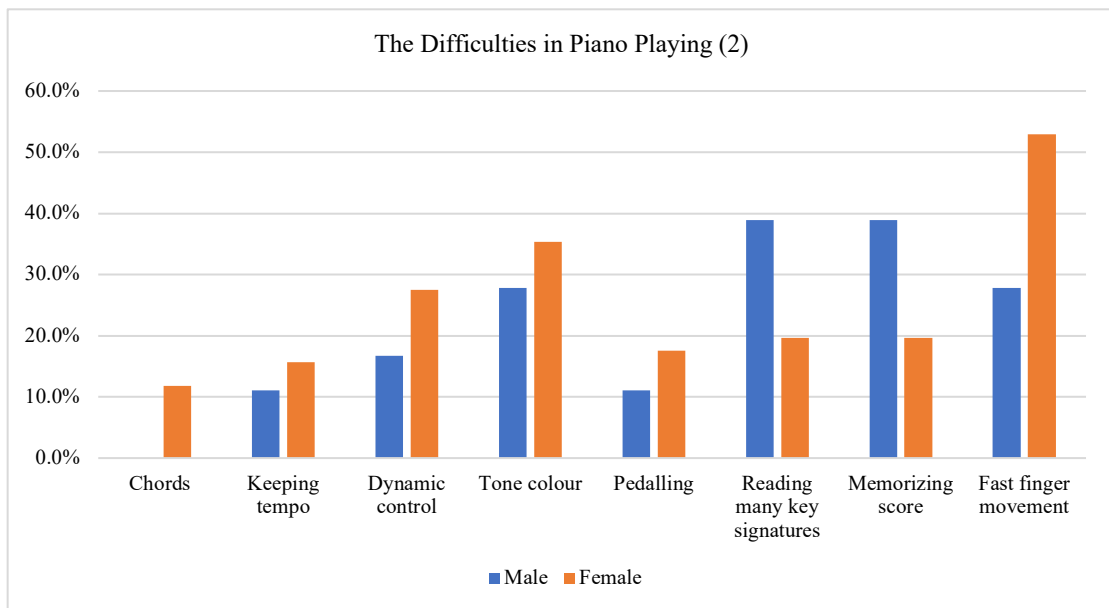
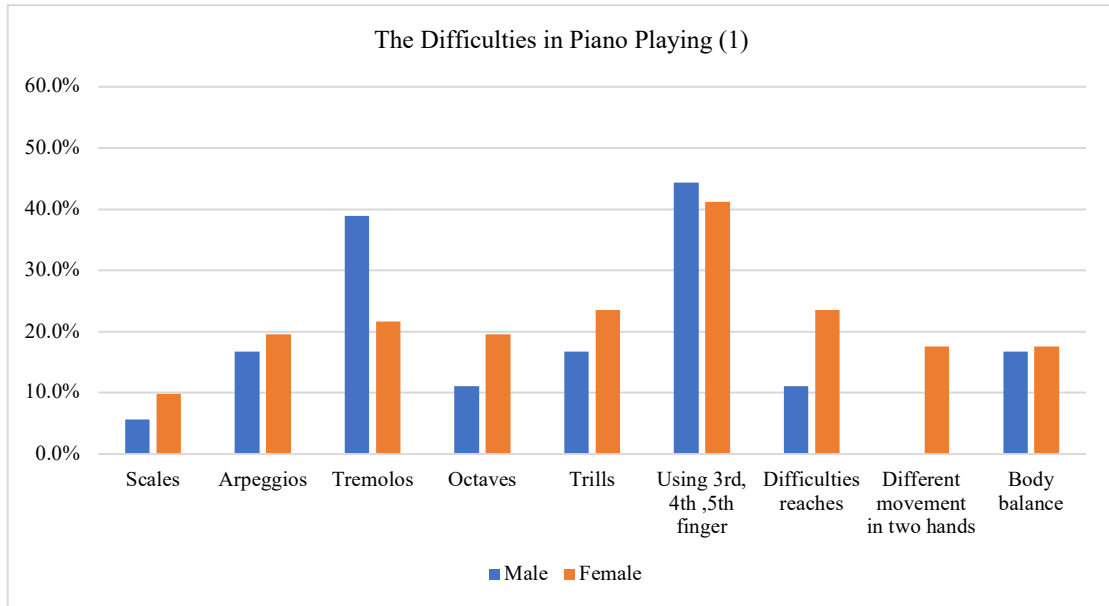
Graph 3.16

The difficulties in piano playing (the respondents began studying after ten)



Graph 3.17

The difficulties in piano playing (the respondents began studying before ten)



According to *Graph 3.16* and *Graph 3.17*, I arranged the following table.

Table 3.8

The difficulties for piano students

	After age ten	Before age ten
Male	Using the 3rd, 4th, and 5th finger	
	Fast finger movement Arpeggios Tone colour	
Female	Fast finger movement	
	Using the 3rd, 4th, and 5th finger Dynamic control Tone colour	

Note: The table shows the difficulties of piano students who are not piano majors when practising the piano.

Table 3.8 shows similar results to *Table 3.4*. However, *Table 3.8* only includes non-professional piano students. Therefore, the results above will balance the results of *Table 3.4*; thus, we can obtain the difficulties that adolescent beginners feel when practising the piano. The difficulties are 1) using the 3rd, 4th, and 5th finger; 2) fast finger movement; 3) arpeggios. Besides these, issues such as different movement in two hands and dynamic control were selected by a large proportion of piano majors and minors.

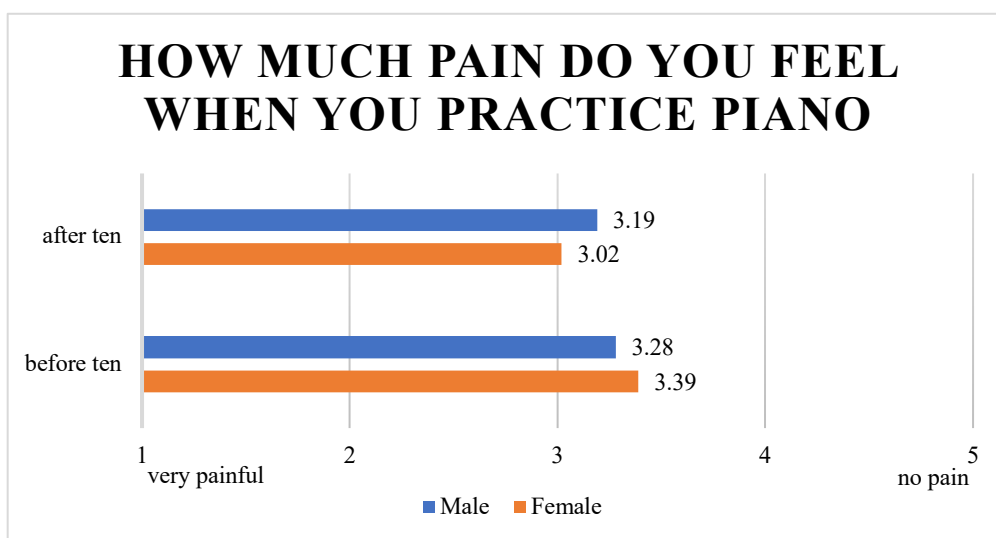
Table 3.9

Average daily practice time

	After age ten	Before age ten
Male	124.59 min	139.17 min
Female	92.32 min	112.76 min

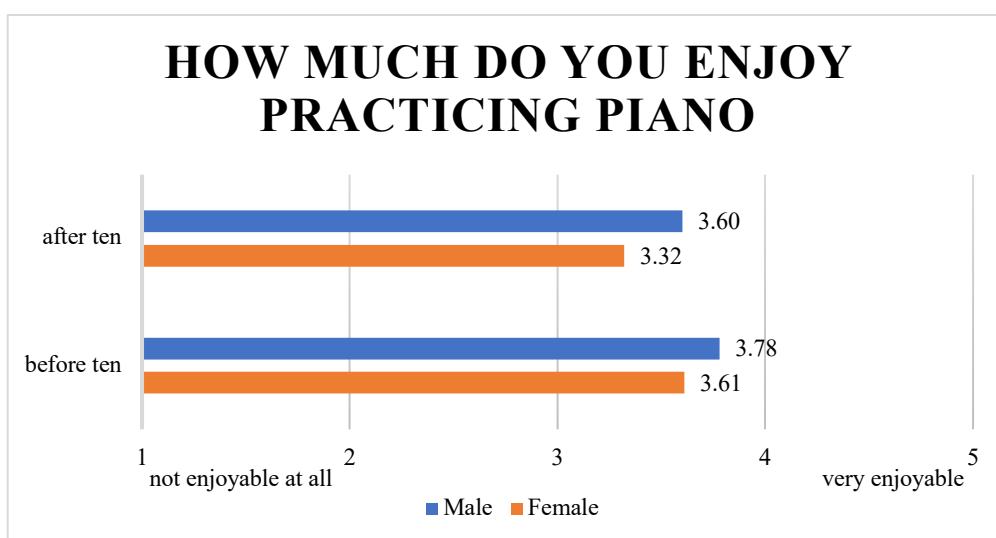
Graph 3.18

How much pain do you feel when you practice the piano



Graph 3.19

How much do you enjoy practising the piano



Concerning *Table 3.9*, we can obtain the same results as *Table 3.5*; the students who began learning piano before age ten practice more time than those who began after age ten. Moreover, *Graph 3.18* and *Graph 3.19* show similar results to *Graph 3.12* and *Graph 3.13*. Therefore, we can conclude that whether

these adolescent beginners are piano majors or high school students, the difficulties they encounter in piano practice and their psychological reactions are almost similar. Thus, the result has expanded the scope of application of the pedagogies and methods I am studying.

After two years of the student surveys, I have found some problems that students encounter in piano practice, and their difference in ages and genders can be seen. However, students are only one side of the issue. There is a Chinese saying: “Generally, for matters under heaven, those closely involved cannot see as clearly as those outsiders”. Therefore, investigating the teachers is necessary to take the overall dimensions of students’ problems.

3.2 On Instructors

41 piano instructors including 39 females and 2 males, were surveyed by online questionnaire in 2020. The survey purpose is to find out the problems that instructors face when they are teaching adolescent beginners. One more purpose is to investigate how teachers instruct and what teaching materials they use when teaching adolescent piano beginners. All of the participants were from Japan. This questionnaire includes the following 5 questions (Among them, the questions (4) and (5) are multiple-choice form, and questions (6) – (11) are open-ended questions.):

(1) Personal details (gender, age, and teacher’s teaching experience).

- (2) The age when the teacher began to learn piano.
- (3) The age to start piano lessons. According to the law of physiological development of males and females in adolescence,⁶ the age is divided into different age groups. Among males, the age groups are divided into before age 10, 10 – 14, 14 – 16, 17 – 19, over age 19; among females, the age groups are divided into before age 10, 10 – 13, 13 – 15, 15 – 17, over age 17.
- (4) What kind of problems the teachers felt when they were instructing male piano students who began piano after age ten?
- (5) What kind of problems the teachers felt when they were instructing female piano students who began piano after age ten?
- (6) What kind of teaching materials or pieces are used to teach students who began piano study after age ten?
- (7) How do you teach students who began piano study after age ten, and what is your teaching plan?
- (8) Problems of playing posture in male students.
- (9) Problems of playing posture in female students.
- (10) When teaching students who began piano study after age ten, what problems or confusing things perplex you?
- (11) Please write down any other problems you have in piano teaching.

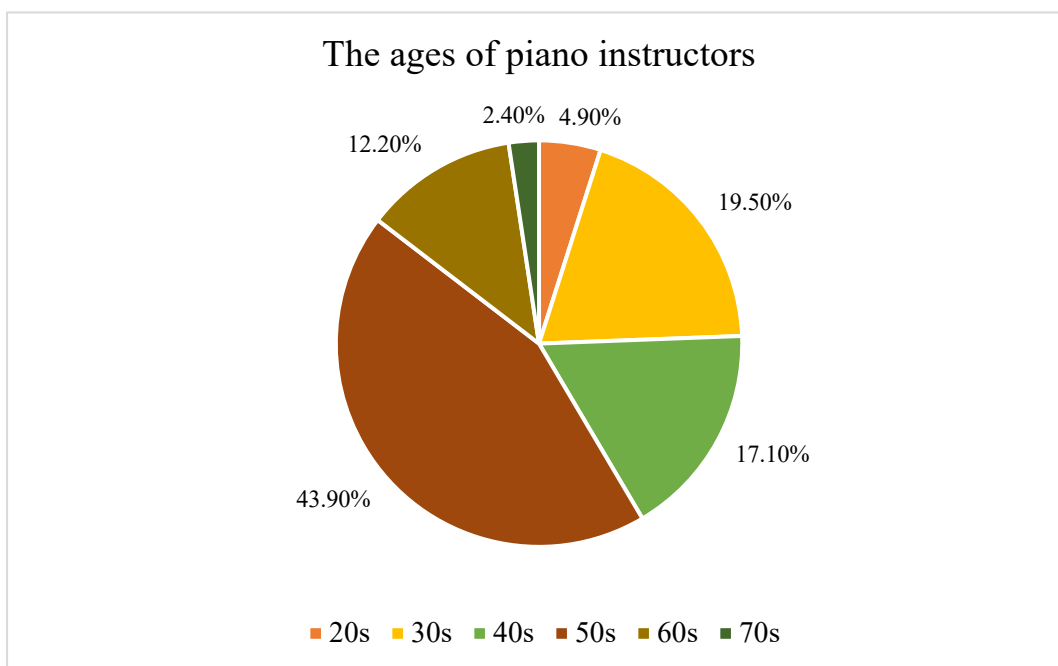
Graph 3.20 and *Graph 3.21* show the result of question (1), personal details.

All participants answered the question.

⁶ Gilsanz, Vicente and Osman Ratib. (2005) *Hand Bone Age: A Digital Atlas of Skeletal Maturity*. Berlin: Springer.

Graph 3.20

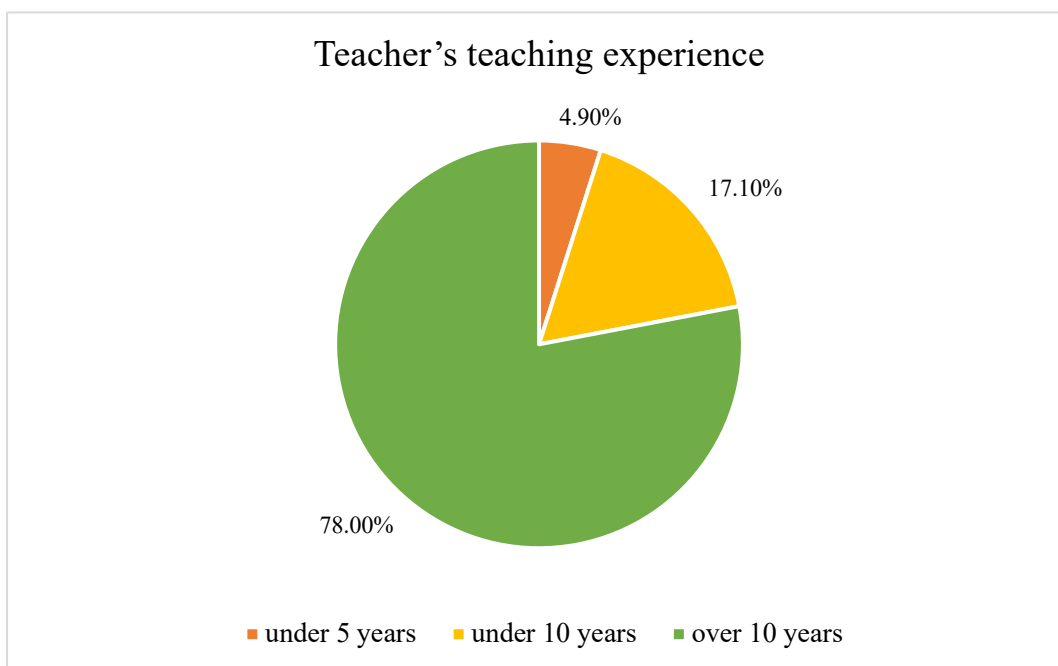
The ages of piano instructors



The graph shows the proportions of piano teacher's ages. Almost half of teachers are in their 50s, which is the largest proportion, and the teachers in their 30s and 40s follow.

Graph 3.21

Instructor's teaching experience

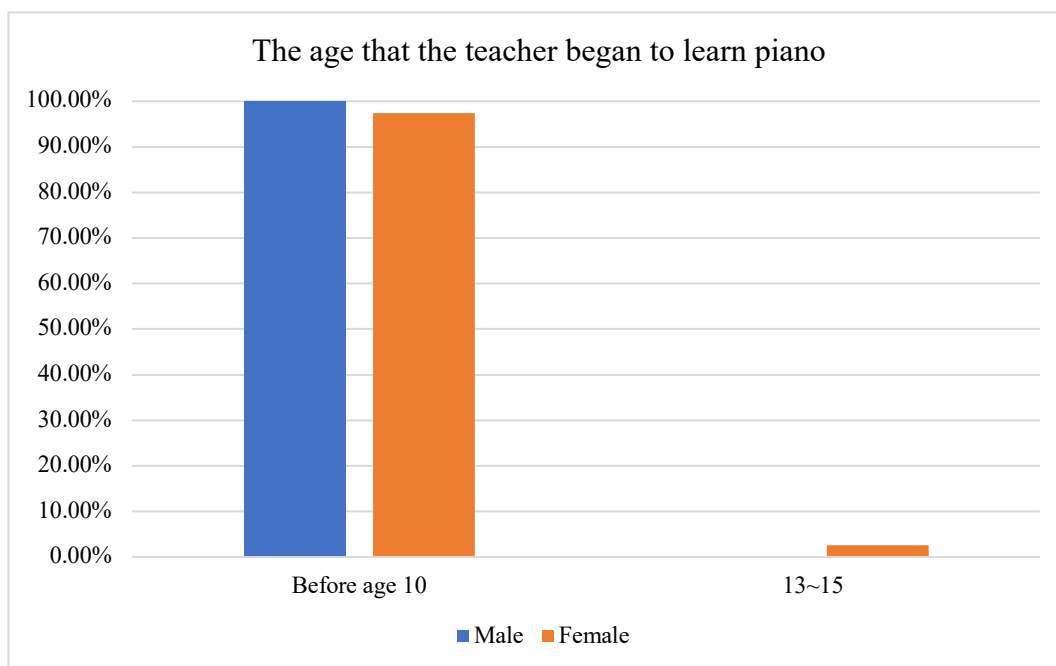


On teachers' teaching experience, 78% of teachers have over 10 years of teaching experience. Such ample teaching experience will provide a more valuable reference for my study.

The following graph shows the result of question (2). All participants responded to the question.

Graph 3.22

The age that the teachers began to learn piano



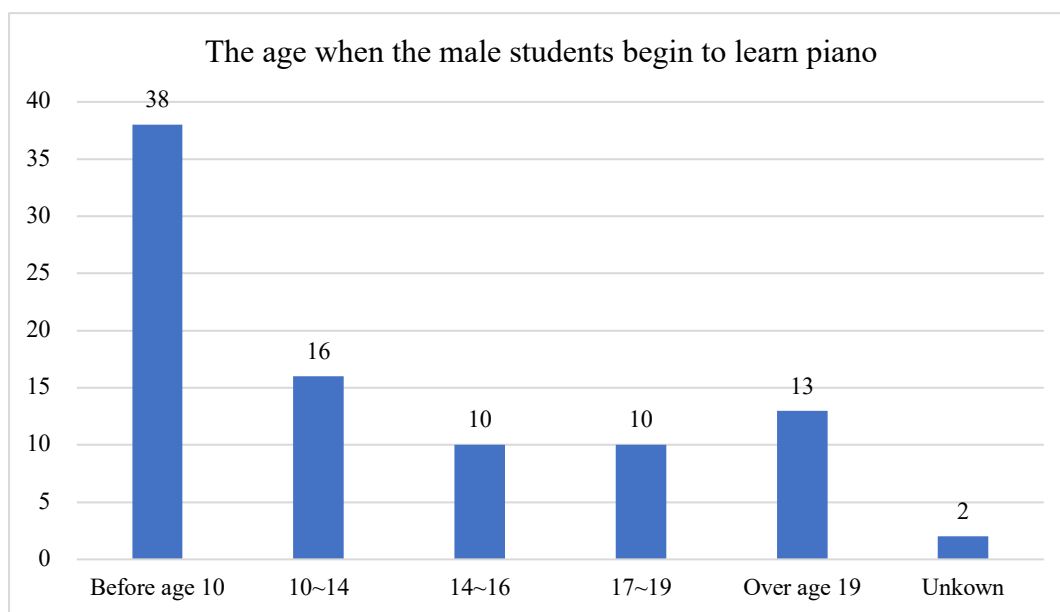
As is shown in the graph above, almost all teachers started to learn piano before age ten, and few teachers started after age ten.

The following *Graph 3.23* and *Graph 3.24* reveal the result of question (3).

All participants answered the question.

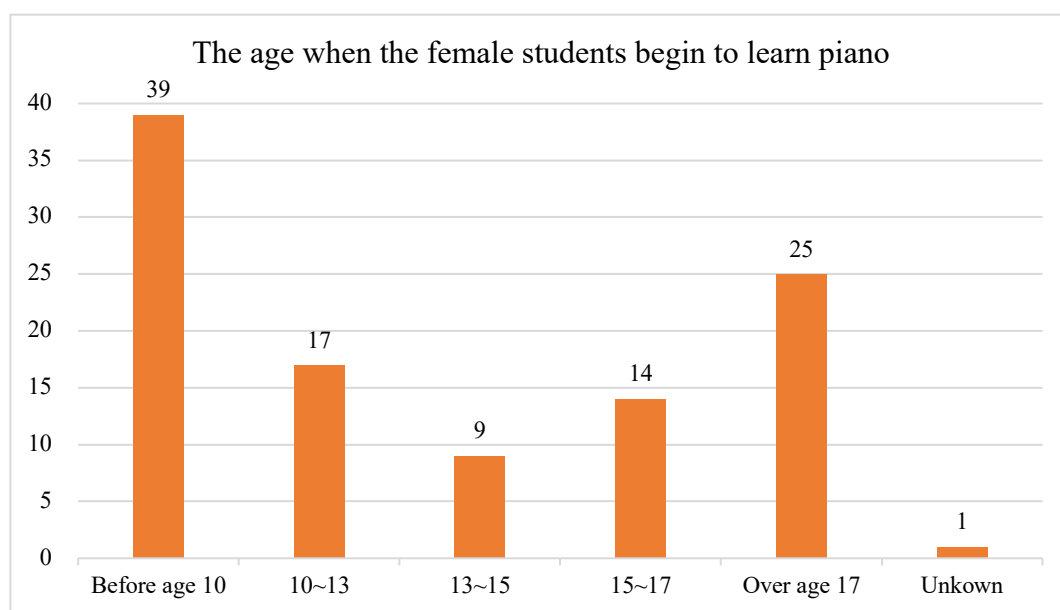
Graph 3.23

The age when the male students began to learn piano



Graph 3.24

The age when the female students began to learn piano



The statistics lead us to conclude that most teachers' pupils began piano study before age ten, but also many students began study after age ten, especially

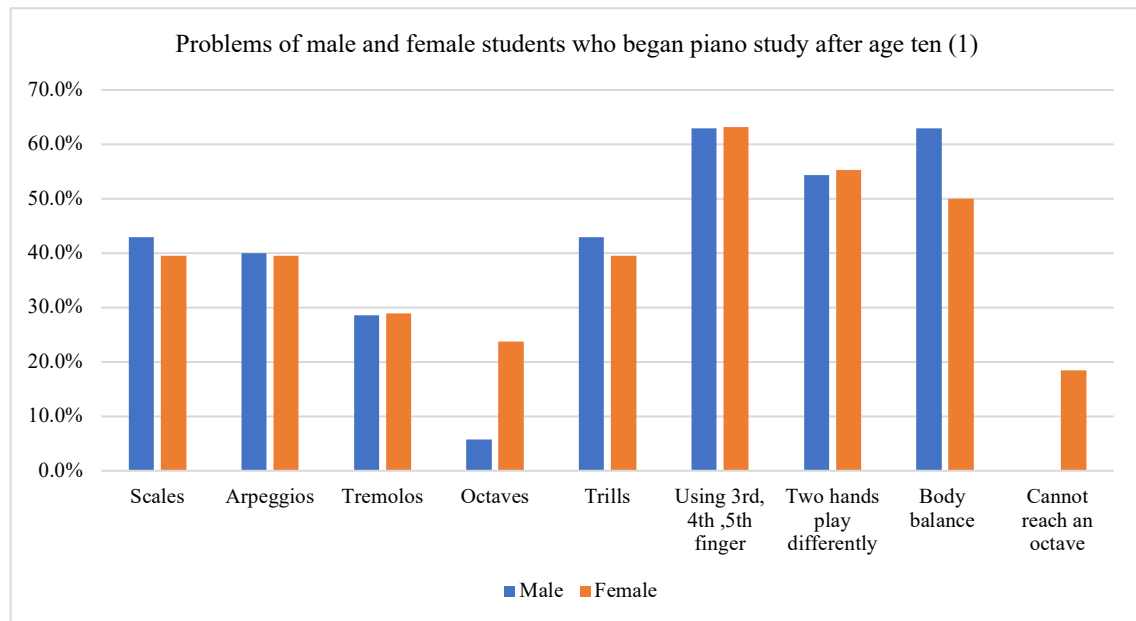
female students. Thus, it demonstrates that many of the instructors surveyed have obtained experiences in teaching students who began to study the piano after ten years old. Therefore, for the following survey results, more value for the focus of my research.

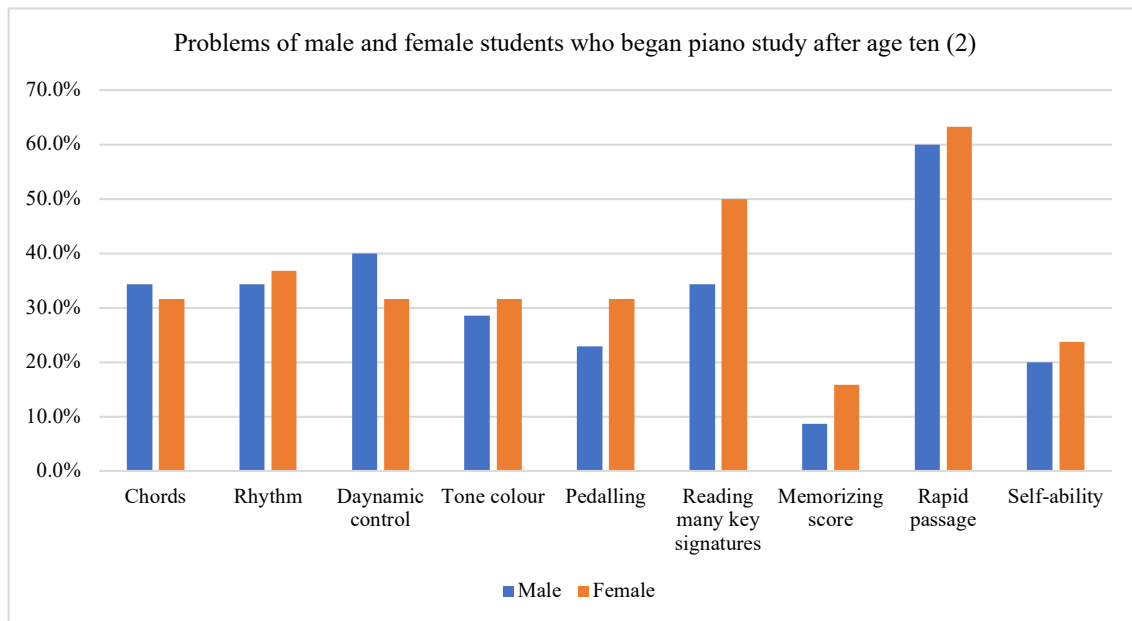
Concerning questions (4) and (5) related to students' problems that teachers encountered in their teaching, I summarised the following 18 items to conduct a multiple-choice survey, and these choices are based on the previous research in 2018 and 2019. In the graphs below, the 17 items are short for the words in parenthesis. 1. Cannot play scales well (scales); 2. Cannot play arpeggios well (arpeggios); 3. Cannot play tremolo well (tremolos); 4. Cannot play octaves well (octaves); 5. Cannot play trills well (trills); 6. Cannot move the 3rd, 4th and 5th finger flexibly (using 3rd, 4th and 5th finger); 7. Insufficient balance when two hands play differently (two hands play differently); 8. Insufficient balance of the body (body balance); 9. Cannot reach an octave; 10. Difficult to play chords (chords); 11. Cannot feel rhythm well (rhythm); 12. Difficult to control dynamics (dynamic control); 13. Difficult to notice tone colour (tone colour); 14. Cannot use pedal well (pedalling); 15. Difficult to read scores with many sharps or flats in the key signature (reading many key signatures); 16. Difficult to remember scores (remembering score); 17. Cannot play rapid passages well (rapid passage); 18. Inadequate self-study ability, such as not considering fingering and looking up music terms by oneself (self-ability).

Concerning these two questions, for the survey on late-beginner male students, there were 35 replies, and another 6 instructors were without experience in teaching late beginners; for the survey on late-beginner female students, there were 38 replies, and another 3 instructors were without experience in teaching late beginners. *Graph 3.25* reveals the result of the questions (4) and (5).

Graph 3.25

Problems of male and female students who began piano study after age ten





These two graphs illustrate the problems teachers encounter or perceive when teaching students who began piano study after ten years old. Firstly, we notice that over 50% of teachers think the problems among male and female students are: 1. Cannot move the 3rd, 4th, and 5th fingers flexibly; 2. Insufficient balance when two hands play differently; 3. Insufficient balance of the body; 4. Cannot play rapid passage well. Problems 1 and 4 also exist among the late-beginner students on the grounds of the survey results from 2019. However, the other two balance problems are not the most difficult points among late beginners. It can be explained that these late-beginning students pay too much attention to the movement of the hands while ignoring the coordination of the whole body and playing posture, which are considered to be the two reasons it is difficult to get improvement quickly among the late beginners.

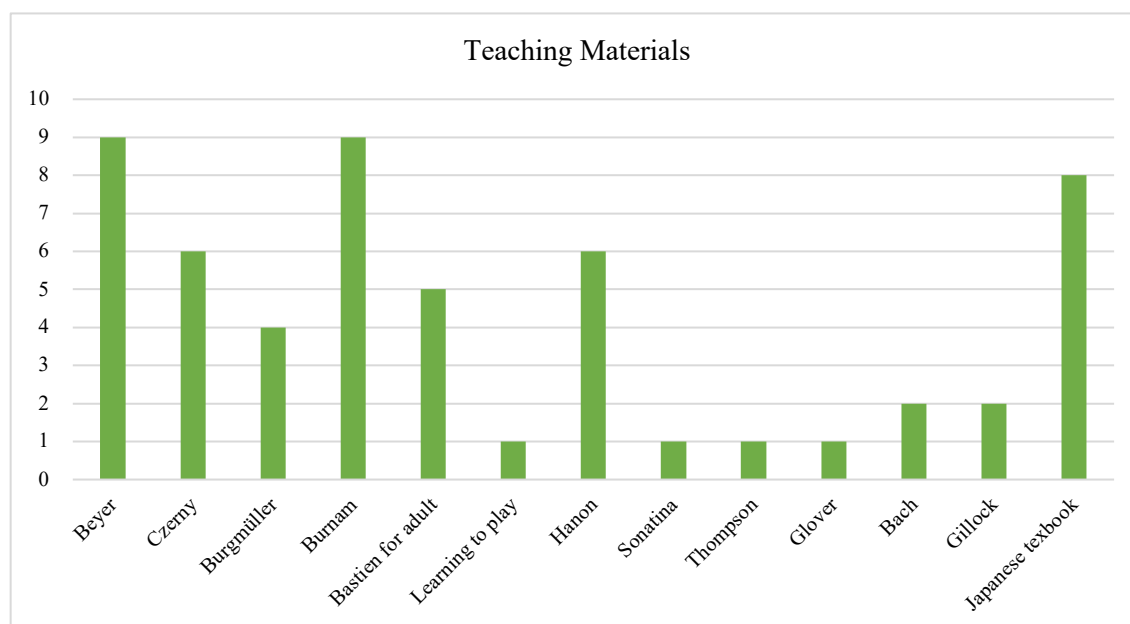
The second thing we noticed is individual gender differences. The role of

gender can be seen from the graphs above and is reflected in the following four problems: 1. Cannot play octaves well; 2. Cannot reach an octave; 3. Cannot use pedal well; 4. Difficult to read the score with many sharps or flats in the key signature. The first two Problems 1 and 2 are related to physiological differences. However, in the 2019 survey, more male than female late beginners think octaves are a problem; it could be that male teenagers are not as physically supple as females. On the other hand, because some girls are born with small hands, they cannot reach an octave. Concerning the last two problems, the result of problem 3 is opposite to that of 2019, but problem 4 is consistent with that of 2019. Lack of solfeggio practice and music theory knowledge are considered to be the causes of these two problems.

The following *Graph 3.26* shows us the result of question (6), “What kind of teaching materials or pieces are used to teach students who began piano after age ten?”. All of the participants responded to the question.

Graph 3.26

Teaching materials used in lessons by instructors



From the graph, we can see that many teachers are still using traditional teaching materials such as Beyer, Czerny, and Hanon. At the same time, many teachers are using original Japanese teaching materials as well. This is a strategy that uses local music to help learners familiarise themselves with melodies fast, which is also a developing trend in China. This trend does not involve blindly learning from Western music, but instead incorporates Chinese folk music into piano works and collections. Many short and straightforward Chinese folk songs are added to the piano teaching materials as well. China's music education is gradually becoming nationalized which is reflected in the book⁷ written by the author in 2020. These familiar traditional melodies can promote the piano

⁷ Wen, Wang, Dong Yizhi, Yang Qing. (2020) *The Study on the Nationalization of Chinese Piano Music in the New Era*. Chengdu: Sichuan national publishing house.

learning process and help students understand piano playing better.

Moreover, in the survey results, Bastien's teaching material is for adults, and there is another material popular around Japan, the Burnam textbooks. Edna Mae Burnam⁸ is famous for her piano pedagogy. The most celebrated method is the *A Dozen a Day* series, which includes piano rudiments and playing posture. Within the series, there are several courses named *Step by Step* piano course. This method guides students to understand music and is a good textbook that can be used for adolescent beginners because it is highly logical.

Regarding the result of question (7), "How do you teach students who began piano study after age ten, and what is your teaching plan?": According to the answer, I made an inductive analysis which shows that most piano teachers instruct students to study score reading, music theory, finger movement, and rhythm at the beginning. Because teachers believe that late beginners have an ability to comprehend abstract matters, helping adolescent beginners understand music can rapidly improve their piano playing techniques. Moreover, as a late beginner, I also realised that I lacked a sense of rhythm when playing the piano. However, after I found my rhythmic sense, I am aware that I had a better performance and understood music better. Therefore, grasping rhythm should be a focus in the first learning step for late beginners.

⁸ Edna Mae Burnam (1907-2007) was an American piano educator.

Besides the teaching methods above, some teachers think choosing suitable pieces and guiding students according to their purpose are essential points. From the background research of Chapter I and the motivation of the piano learning survey in 2019, we can see that plenty of late beginners have their purpose to begin studying piano. Therefore, this is a good strategy for guiding late beginners. On the other hand, many teachers think cultivating students' interest is the most important thing because interest is the best teacher. Hence, they choose pieces that students enjoy practising, which can improve their learning enthusiasm.

Furthermore, a few teachers consider that piano playing posture, relaxation, and cooperation of motor organs should be taught to late beginners at first. This result will be noted in Chapter IV and discussed in Chapter V. It is the nature and economical posture could help adolescent beginners avoid detours. Also, some teachers think solfeggio needs to be introduced to late beginners as early as possible, as Chopin said the ear is the best teacher for a piano player. Other answers include that teachers should communicate with students more, encourage students to practice the piano, and help them improve their self-confidence. Because teachers have realised that some of the late beginning students feel inferior, it is also vital to help them overcome their psychological difficulties. The methods and pedagogies of teachers analysed above will be combined with the research of Chapter IV, and then it will take the shape of a perfect teaching system in Chapter V.

About question (8), “problems of playing postures in male students”, 33 teachers responded, and another eight did not answer the question. The teacher’s answers about the posture problems in late-beginner males mainly include the following aspects: a bent back, a high bench, and sitting far from the piano. In addition, some teachers said that many students get stiffness in the shoulders when playing the piano. A good sitting posture will bring a relaxed experience to piano playing. At the same time, if students learn to relax their bodies, especially their arms, it will significantly impact the effect of piano playing.

Concerning result of the question (9), “problems of female students in playing posture”, 30 teachers responded, and the other 11 did not answer the question. The teachers’ answers about posture problems in female late beginners are almost the same as the above. Nevertheless, two problems are not mentioned among male students: folding fingers and pushing from the hands without finger articulation.

Whether in male or female late beginners, it is common that the body is easily becomes stiff in playing; however, due to gender and individual differences, the problem manifests in different ways. Therefore, according to the survey, these clues provided by teachers will be considered and discussed in the method research in Chapter V.

Regarding the result of the question (10), “When teaching students who

began the piano study after age ten, what problems or confusing things perplex you?": There are 40 respondents, and one teacher did not answer the question. The responses to this question, aside from responses that duplicate answers to the last question, include insufficient practice time (lots of students need to finish homework and go to other extracurricular activities), weak fingers, difficulties making beautiful sounds, and playing music by feeling instead of understanding it. Additionally, there are some psychological answers, such as students wanting to obtain success as soon as possible, wanting everything perfect, and preferring to take a shortcut. Moreover, teachers think they should pay attention to their mood and manner of speaking because adolescent beginners have weak self-esteem and compare themselves to other students, which is motivated by vanity in adolescence.

As can be seen from the results above, adolescent beginners are different from early beginners in terms of physiology, and psychological maturity affects piano learning as well. However, adolescent beginners still possess many advantages. As one of the teachers replies, in addition to those students who have a specific purpose, most adolescent beginners come to learn piano spontaneously, which helps teachers find an assistant – interest. Meanwhile, adolescent beginners' left brain has become a "theoretical brain" that I called, enabling them to understand the essence of music better than early young beginners.

Regarding question (11), "Please write down any other problems you have":

There are 27 teachers who did the supplements, and 14 teachers who did not. After removing answers that duplicate responses to previous questions, teachers responses include the following points: Basic technique practice is essential; touch is difficult for late beginners; students are full of ardour at the beginning, but once they suffer difficulties they lose it; it is difficult to correct a terrible playing habit; the students are usually not interested in learning because they feel their fingers are weak; it is not a problem for students to understand music but to express music.

The results above demonstrate that with increasing age, the sensitivity of nerves decrease, which leads to the key touch problems in late beginners. With the variety of problems emerging, it gradually wipes out the students' desire to learn the piano. Hence, many late beginners want to obtain results and skip over basic exercises quickly. Consequently, when these students consolidate basic skills, they need to be encouraged and given more patience and support from instructors. Besides, as a late beginner, I was also confused as to why I could not express music well with the piano, even if I could understand the music. I think causes of this problem are multifaceted. It needs physiology, psychology, and even psychiatry to explain in future research.

After three years of questionnaire research, I found the problems of late and early beginners and the problems that teachers have perceived in piano education. By comparing and analysing the problems in students and instructors, I have

sought out the problems that students urgently need to be solved. To solve these problems, we need not only modern piano method research as a reference, but also a clear understanding of the origin and development of piano playing. Thereupon, we must reexplore the development of piano methods and pedagogies in the past three centuries to learn if any scientific and reasonable methods could be used for adolescent beginners.

3.3 Piano Lesson Audit Report

The previous three surveys have shown us the difficulties that many students encounter in piano practice and the confusion of teachers in teaching. However, how do teachers guide students who start late in the real educational environment? What are the problems faced by these students? How do they feel about learning? Therefore, to listen to other instructor's piano lesson be an important study. As an auditor, we can enter the role of teacher and student from the other instructor's class and think from students' perspectives. When we listen to other instructors' lessons, we can think about how to face adolescent beginners if we are the teacher. We can find the advantages and disadvantages of the pedagogies through other instructors to improve our teaching theory and experience. In addition, we can find the typical and universal problems in other instructors' teaching by looking at the overall situation. Therefore, it is of great reference value for improving our teaching methods to learn from the characteristics of other instructors and find the shortcomings of students. Thus, in order to get more survey feedback and

verify the results obtained in the questionnaires, I have audited the non-speciality piano student lessons during October – December 2018. There were seven students’ lessons I have audited.

Table 3.10

The information about the students

Student	Grade	Piano Starting Age
A	3	Age 9
B	3	Age 5 (age 14 – 16 blank*, restarted age 17)
C	2	Age 16
D	1	Age 5 (one month learned, restarted age 17)
E	2	Age 15
F	1	Age 4 (age 15 blank*)
G	1	Age 16

Note: “Blank” means the student did not study the piano during that period.

The audited students are all female students and come from the Elisabeth University of Music. They almost all started learning piano after age ten, except students B, D, and F. However, although students B, D, and F started learning piano before age ten, they are unfamiliar with the keyboard and cannot control their fingers well. Next, I will introduce the class situation of these students separately.

Student A started piano at age 9 and graduated from music high school. She has studied lots of works written by Bach, Beethoven, Mozart, and Czerny, but she has not played any of Chopin’s etudes yet. Her teacher planned to give her a new Debussy piece, *Children’s Corner, No. 1 Doctor Gradus ad Parnassum*. When she started to study music, she used a Japanese textbook. On the other hand,

I observed the following problems and difficulties when she plays the piano, and this includes some information obtained after I interviewed her: 1) The third joints of her fingers are still weak, and she did not use CM joint correctly; 2) the left hand plays the wrong bass notes and harmony frequently; 3) there is poor balance of both right and left hands, and the melody of the right hand cannot be heard clearly; 3) when playing slowly many more wrong notes occur; 4) after keystroke, the wrists move forward and upward. The instructor gave the following practice advice: 1) Find the cadence in order to know the bass of the left hand; 2) play the bass and melody only; 3) find the different themes; 4) analyse the different voices; 5) explain the meaning of music terms.

Student B started piano at age 5, but she had a hiatus from 14 ~ 16 years old and restarted at age 17. She has learned to play Beyer, Hanon, and Czerny. The following are problems and difficulties that I observed when she plays the piano, and it includes some information obtained after I interviewed her: 1) Although she has a good hand posture, the utilisation of arms is still a problem; 2) it is difficult to use the 3rd, 4th, and 5th fingers; 3) it is difficult to balance two hands. In the lesson, the instructor gave the following practice advice: 1) Analyse the tonality; 2) play with forte; 3) explain the phrases; 4) count the rhythm. After the lesson, I interviewed the instructor. She thought that the most significant difference between piano minor students and major students is that piano minor students do not know their situation and condition well, but the major students know it better.

Student C started piano at age 16, and she has studied three years until now and has studied Hannon and Czerny. Student C wants to be an elementary school teacher; hence, she must participate in the test, for which she needs to play a classical work and two accompaniments. Her teacher often uses physical finger exercises, which is the Mikimoto method introduced in Chapter V, and strictly requires playing posture. I audited student C's lesson five times and observed her changes and progress under the teacher's scientific guidelines. For the first time, it was found that the student is weak when using the PIP joint of the finger, but her hand posture is correct. Moreover, she depresses the pedal loudly, and her upper arms, shoulders, and upper body look very stiff. The teacher's strategies are the following: 1) The waist supports the body well, and other parts of the body are stable, so depress the pedal with the ankle to reduce the pedal noise, and practice only with the left hand and the pedal; 2) for the jump technique, keep the body stable and practice with the elbows, and practice with various rhythms, The eyes should notice the left hand (because of the left-hand jumps); 3) think about the music's theme.

The instructor noticed a new problem in the second lesson. Student C played keys by pushing the from the wrist and using the MCP joint. At this time, the instructor fixed her fingering and taught her how to concentrate the power to the fingertip to improve the student's weak fingers. At the end of this lesson, the teacher helped the student understand the music's melody and dynamic changes. However, the teacher did not suggest to her how to perform keystrokes by using

the MCP joint.

In the third lesson, in order to help understand the harmonic colour of the music, the teacher improved student C's tone colour, but her left hand still could not play fluently. Thus, the instructor corrected her pedal again and explained how to play the phrases. After the lesson, the teacher told me the piano minor students do not have to practice too much with the fifth finger, but the piano major students have to do so.

In the fourth lesson, a problem I found in student C is that her DIP joint depresses inward, and it happened in the second and third fingers of the left hand, and the second and fourth fingers of the right hand. Also, when she strikes the keys, her fingers do not make it to the bottom of the key bed completely. However, in this case, her DIP joint is not depressed inward. Furthermore, during the lesson, she told me that she feels it is difficult to play different things with both hands, and I found that when she plays different things with two hands, her body is unstable. Her instructor has emphasised the function of the ears this time and described the way to express a long phrase.

In the last lesson, student C has got to know the music well, and the instructor guided her in the following ways: 1) When playing parts like arpeggios, the shoulder and upper arm should be relaxed; 2) explain the movement direction and method of both hands; 3) the body should be stable because it is a pivot; 4)

memorise the piece as soon as possible. After five lessons, student C made significant progress, but the coordination of the playing apparatus is still not ideal. The instructor talked a lot about using the body because the teacher values the significance of playing posture and helps the student understand music. The student can practice competently for a short time, and the effect is apparent.

Student D started piano at age 5 but only studied for one month, and then she restarted it at age 17 when she was a first-grade university student. She never used systematic teaching materials, only played some of Burgmüller's pieces, and never learned Hanon until university. In her lesson, I found she plays the piano with good hand posture, and her coordination is more natural than other students mentioned above. However, there were several problems with her left hand, such as the fingering and a lack of control. Her teacher's teaching method is as follows: 1) For scales, have the student practice with a single hand and observe the fingering; 2) when playing the scale, the student should keep the wrist and forearm stable; 3) help students understand music in terms of rhythm, music terminology, etc.

Student E started piano at age 15, and she wants to be a kindergarten teacher. So far, she has played the works of Hanon, Czerny, Mozart, Beethoven, and Bach. Perhaps the student learned different kinds of pieces. She has a good hand posture, and when she plays the piano, her fingers can stand on the keys. However, one thing I noticed is that her balance does not seem good while she plays with both

hands. Thus, the teacher gave various music ideas in this class, including music terminology, and analysed the musical phrases.

Student F started piano at age 4, and she did not learn the piano in the third grade of middle high school. This student likes to play pop music, hence she never played Bach or Chopin, but she has learned Bastian and Burgmüller. However, she told me that she had to look at her hand to play or else she makes many mistakes. Besides, I found that her fifth finger cannot support the hand, and her DIP joint is weak, though her hand posture is good. The teacher's method for the student is correcting the fingering, finding the tonality, and helping her interpret the music texture.

Student G started piano at age 6 when she was in the third grade of high school, and she has studied several sonatinas. I found she has two big problems. One is that her MCP joint did not support her hand; the other is that she is confused with fingering. Also, she has the same problem as Student F: her eyes are on her hands instead of the score. Her teacher's strategies are as follows: have the students practice the scales with different rhythms to correct fingering mistakes; find the tonality and emphasise that she should look at the score while playing the piano.

As can be seen from the class of the seven students, many problems that occurred in fingers can be attributed to incorrect hand posture and bad

coordination of the muscles. As for the balance problem, first of all, it is caused by the influence of proprioception in adolescent development. Secondly, students pay too much attention to using small muscles but ignore overall coordination. Additionally, the piano learning period impacts the brain's feedback. When learning for a long time, it is easy to form a non-conditional reflex. Conversely, a short period of study or practice cannot stimulate the brain to produce reactions quickly, which requires more training. However, the adolescent beginners can form a non-conditional reflex in obtaining information from music scores as very soon if they start training with music theory. Furthermore, in the aspects of balance and coordination, the early beginners seem better than the adolescent beginners, and when it comes to hand posture as well. Additionally, I found that teachers usually guide the piano minors in a strategy that solves the technique problems as early as possible, then help students to study musicality later. However, as we will see in the next chapter, this strategy does not seem to be a reasonable approach for late beginners.

Chapter IV: Piano Methods and Pedagogies for Adolescent Beginners in the Past Three Centuries

This chapter will introduce more than thirty representative keyboard pedagogy and method books during the 18th, 19th, and 20th centuries. These method and pedagogy books are written by pianists and educators such as F. Couperin, C.P.E. Bach, M. Clementi, J.N. Hummel, C. Czerny, F. W. M. Kalkbrenner, and G. Sándor. I searched for methods and pedagogies that can be available to adolescent beginners through researching those books. This sampling can show us the evolution of piano methods and the revelatory scientific methods and pedagogies they employed.

In the 18th century, Couperin was a pioneer of piano methods because of his advanced opinions concerning technique, such as playing the keyboard by using the wrist. Moreover, he emphasised posture and limb relaxation. Couperin realised the influence of gender differences and age on piano playing. This viewpoint shows the great foresight Couperin had in matters essential to piano playing. After Couperin, revolutionary developments in the mechanics and organization of keyboards occurred, and it had an enormous impact on the development of keyboard methods. In the 19th century a lot of piano methods for the practice of basic techniques arose, and simultaneously, many physical fingers exercise devices were created to improve finger function. We can see a

burgeoning demand for improved methods in this century. Moreover, Deppe put forward a theory of muscular synergy; then Breithaupt established a revolutionary method school named “weight-touch.” These two methods changed and accelerated the improvement of old German school methods, and they provided more reasonable and natural methods for piano playing. At the end of the 19th century, with the development of technology, the application of physics, physiology, and psychology was brought into piano methods. There are several representative researchers, such as Matthay and Ortmann. They focus on the nature of physical movements, including utilising body levers and arm motion patterns. Especially, Ortmann has explained weight-touch and proved the science of weight-transfer through experiments. Furthermore, he also emphasised the function and importance of psychology in piano playing. Unfortunately, this view has only been put forward and has not been proved by his research. Since the 20th century, modern experiments have verified plenty of past theories and hypotheses, such as weight-touch, weight transfer, and the interrelations between small and large muscles. Even those experiments have analysed the arm and hand movements using basic mechanics and lever principles, but the results are not systematically and scientifically used for piano education. Additionally, in recent years, more and more scientists and educators have been turning to neuroscience for answers and dedicating themselves to unravelling the mysteries of piano playing. Thus, the research on piano playing methods and pedagogies continues and is becoming more scientific and humane. With the rapid development of

technology in this information age, it is urgent to find a systematic and scientific practice method for adolescent beginners. However, all this needs to be developed based on history, so it has become a top priority to find methods that can be applied to adolescent beginners in the past three centuries.

I studied the following method and pedagogy books, and the relevant contents were selected and summarised, such as hand position, scales, arpeggios, harmony, muscle use, and other key elements. Then I classified them into four aspects: “performance posture”, “basic techniques”, “musical theory”, and “physiological viewpoint”. Finally, I summarised the general trends in piano practice methods and pedagogies across three centuries. Thus, we can learn from past and current piano education practices and find the best methods for adolescent beginners going forward.

The 18th Century:

1. Couperin, François. (1717) *L'art de toucher du clavecin*.
English Version: *The Art of Playing the Harpsichord* (1974).
2. Rameau, Jean-Philippe. (1724) *Méthodes pour la mécanique des doigts ou l'on enseigne les moyens de se procurer*.
3. Forkel, Johannes Nikolaus. (1802) *Über Johann Sebastian Bachs Leben, Kunst und Kunstwerke: Für patriotische Verehrer echter musikalischer Kunst*.
English Version: *The Life, Art and Artistic Works of Johann Sebastian Bach* (1920).
4. Bach, C.P.E. (1753) *Versuch über die wahre Art, das Clavier zu spielen*.
(English Version: *Essay on the valid method of playing the clavier* (1949).)
5. Hook, James. (1785) *Guide di music*
6. Türk, Daniel Gottlob. (1789) *Klavierschule oder Anweisung zum Klavierspielen für Lehrer, mit kritischen Anmerkungen*.

7. Dussek, Jan Ladislav. (1796) *Dussek's Instructions on the Art of Playing the piano Forte or Harpsichord.*
8. Milchmeyer, Jan Peter. (1797) *Die wahre Art das Pianoforte zu spielen.*

The 19th Century:

1. Clementi, Muzio. (1803) *Introduction to the Art of Playing on the Piano Forte: Containing the Elements of Music, Preliminary Notion on Fingering, and Fifty Fingered Lessons.*
2. Adam, Louis. (1804) *Méthode de piano du Conservatoire.*
3. Graupner, Gottlieb. (1806) *Rudiments of the Art of Playing on the Piano Forte.*
4. Steibelt, Daniel. (1805) *Méthode de piano.*
5. Logier, Johann Bernhard. (1827). *A System of the Science of Music and Practical Composition.*
6. Hummel, Johann Nepomuk. (1828) *Ausführliche theoretisch-praktische Anweisung zum Piano-Forte-Spiel.*
English Version: *A Complete Theoretical and Practical Course of Instruction on the Art of Playing the Piano Forte* (1828).
7. Czerny, Carl. (1839) *Pianoforte Schule.*
8. Kalkbrenner, Friedrich Wilhelm Michael. (1830) *Méthode pour apprendre le piano à l'aide du guide-mains.*
9. Latour, Jean Théodore. (1832) *New and Improved Method of Instruction for the Pianoforte.*
10. Hüntten, Franz. (1833) *Méthode de piano.*
11. Herz, Henri. (1838) *Méthode complète de piano.*
English Version: *New and Complete Piano-forte School* (1844).
12. Bertini, Henri Jerome. (1848) *A Progressive and Complete Method for the Piano-forte.*
13. Spencer, Charles Child. (1853) *The Rudiments of the Art of Playing the Pianoforte.*
14. Richardson, Nathan. (1859) *New Method for the Piano-forte.*
15. Plaidy, Louis. (1852) *Technische Studien für das Pianoforte spiel.*

English Version: *Technical Studies for the Piano* (1875).

16. Pauer, Ernst. (1877) *The Art of Pianoforte Playing*.

The 20th Century:

1. Brée, Malwine. (1902) *The Groundwork of the Leschetizky Method*.
2. Caland, Elisabeth. (1903) *Artistic Piano Playing as Taught by Ludwig Deppe*.
3. Philipp, Isidor. (1908) *Complete School of Technic for the Pianoforte*.
4. Breithaupt, Rudolf Maria. (1909) *Natural Piano Technique Vol. 2: School of Weight-Touch-Natural Piano Technic*.
5. Ortmann, Otto. (1929) *The Physiological Mechanics of Piano Technique*.
6. Matthay, Tobias. (1932) *The Visible and Invisible in Pianoforte Technique*.
7. Newman, William Stein. (1956) *The Pianist's Problems*.
8. Whiteside, Abby. (1961) *Indispensables of Piano Playing*.
9. Gát, József. (1968) *The Technique of Piano Playing*.
10. Sándor, György. (1982) *On Piano Playing: Motion, Sound and Expression*.
11. Fassina, Jean. (2000) *Lettre à jeune pianiste*.

4.1 Introduction to Piano Methods in the 18th Century

Before the 18th century, there were few keyboard pedagogies. Girolamo Diruta⁹ wrote a vital treatise, *II Transilvano*, and it is the first keyboard pedagogy written in Italy. It includes two parts, the first part published in 1593, another part in 1609. This book is written in the form of a dialogue between Diruta and Transylvanian¹⁰. In Part I, Diruta explains brief music theory concepts, hand and finger position, the function of the arm, keyboard attack, using fingers,

⁹ Girolamo Diruta (around 1546 – 1625), Italian organist, teacher, and music theorist.

¹⁰ Referring to the prince of Transylvania, Sigismund Báthory (1573-1613).

ornaments, and fingerings; he also supplemented with 13 *Toccatas* for practice. In Part II, Diruta supplements with many musical examples and illustrates how to play them. *II Transilvano*, as the first keyboard manual, not only influenced the late 16th-century Venetian school of keyboard music but also played an essential role during the history of Western keyboard music. Moreover, *II Transilvano* talked about the organ's methods and pedagogies. With the emergence of more and more keyboard instruments during the 18th century, methods and pedagogies were also at a new height.

There are three categories of keyboard instruments. The first category is the string keyboard, which includes three keyboard instruments: 1) Harpsichord and spinet, which are sounded by plucking strings; 2) clavichord and piano, which are sounded by striking strings; 3) bowed clavier, which is sounded by bowing strings. The second category is the organ. There are two types of organs: flue pipes and reed pipes. The former's sound is made by air vibration; the latter's is made by reed vibration. The third category is carillon and glockenspiel. Carillon is usually used in church, and the sound is made by metal clappers striking the bells; glockenspiel is a kind of percussion instrument like the xylophone. Among these keyboard instruments, harpsichord and clavichord were widely used through the Renaissance and Baroque. Plenty of composers composed lots of music for harpsichord and clavichord, such as D. Scarlatti, who composed around 555 harpsichord sonatas; F. Couperin, who wrote the famous method work in 1717, "*L'art de toucher le clavecin*", which illustrated how to play the

harpsichord and is one of the earliest-known keyboard pedagogies; C.P.E. Bach, who composed many sonatas, most of them for clavichord like his famous late clavichord sonata collections “*Kenner und Liebhaber*” sonatas, Wq. 55-59 and 61, composed during 1758 – 1786; J.L. Dussek, who composed many keyboard works including sonatas, ensembles, and concertos, and who collaborated with keyboard builders to advance keyboard design. These educators and musicians not only contributed to musical creation but also suggested practice strategies for students. As a sample from the 18th century, I have selected eight representative methods from François Couperin, Jean Philippe Rameau, Johann Sebastian Bach, Carl Philipp Emanuel Bach, James Hook, Daniel Gottlob Türk, Jan Ladislav Dussek, and Johann Peter Milchmeyer. Because we are still using their methods nowadays, they have been influencing the development of piano performance profoundly until now.

In F. Couperin’s¹¹ book, Couperin mentions how to sit when playing the keyboard, body position, and finger position. Moreover, he discusses how to put the hands on the keyboard and the elbow and wrist position. He emphasizes that players should often and freely use the first finger (thumb). This was an advanced viewpoint in his age. Then he recommends how to correct wrists when keyboardists have too high of a wrist position. (Couperin, 1974) In his method book, there is an important central thought: *As good grace is necessary, one must*

¹¹ François Couperin (1668-1733) was a French composer, organist and harpsichordist.

*begin with the position of the body.*¹² There were only a few teachers who mentioned these teaching methods at that time. Therefore, it can be said that Couperin's method was very advanced in his day. In particular, Couperin mentions two interrelated physiological considerations: muscle development and memorisation. Couperin noticed the influence of gender differences and age on those starting to learn keyboard instruments. He thinks the late beginners and male students usually have stiff hands. This insight is also scientifically advanced in his age. Of course, he also wrote how to practise basic techniques, but there was no mention of scale and arpeggio exercises. (Couperin, 1974) The reason is considered to be the structure of keyboard instruments, because the keyboard was short and small register, it was unnecessary to play too much wide arpeggios and scales.

J.- Ph. Rameau¹³, J. Hook¹⁴, and J.L. Dussek¹⁵ mention basic techniques, but only Dussek (1796) mentions how to practice both scales and arpeggios; Rameau

¹² Couperin, François. (1974) *The Art of Playing the Harpsichord*. New York: Alfred Music Publishing, p. 29

¹³ Jean-Philippe Rameau (1683-1764) was a French composer and music theorist. He is considered the leading French composer for the harpsichord after Couperin.

¹⁴ James Hook (1746-1827) was an English composer and organist. He wrote four pedagogical works. The *Guida di musica* Op. 37 (1785) and the *New Guida di musica* Op. 81 (1796) are for beginners; the *Guida di musica, Second Part* Op. 75 (1794) and *The Preceptor for the Piano-Forte, Organ or Harpsichord* (1795) are for learning fingering and some progressive lessons.

¹⁵ Jan Ladislav Dussek (1760-1812) was a Czech predecessor of romantic period composer and pianist. He also helped Broadwood company to develop piano.

(1724) does not mention scales and arpeggios, and Hook (1785) only mentions scales. The reason is that the instrument they used does not have a wide register. The three of them just wrote a few words about playing posture, and only Dussek (1796) discusses music theory. In addition, Rameau (1724) explains that players should raise their fingers as much as possible when practising trills and should let them be relaxed and flexible. It might be the earliest discourse on finger independence and could be the beginning of the high finger school.

J. S. Bach's method¹⁶ is representative of the 18th century, and his family's methods are similar, almost all of which mention hand and finger position, hand bridge, and talk about basic techniques, although they do not talk much about scales and arpeggios. On the other hand, the Bach family's methods mentioned muscular relaxation, which was scientific. C.P.E. Bach said, *in playing, the fingers should be arched, and the muscles relaxed.*¹⁷ J.S. Bach recognized that fingers' lengths are different, and *players are frequently seduced to use the stronger whenever they can readily do so.*¹⁸ Consequently, J. S. Bach suggests playing each note with an equal sound and having fingers practice passages in every conceivable position. Moreover, Forkel (1802) said that J. S. Bach

¹⁶ The method book written by Johann Nikolaus Forkel (1749-1818), a German musician, musicologist, and music theorist.

¹⁷ Bach, Carl Philipp Emanuel. (1949) *Essay on the true method of playing the clavier*. New York: W. W. Norton. p. 42.

¹⁸ Forkel, Johannes Nikolaus. (1920) *The Life, Art, and Artistic Works of Johann Sebastian Bach*. London: Constable and Company LTD. p. 53.

emphasizes the importance of the thumb because people seldom used their thumbs to play the keyboard until the time of J.S Bach; furthermore, Bach points out that the thumb functions as a central pivot when playing scales and arpeggios.

I want to introduce the last two critical methods in the 18th century from D. G. Türk¹⁹ and J.P. Milchmeyer²⁰. Türk inherited C. P. E. Bach's theories, which advocate arched fingers and relaxed muscles. In his book, Türk mentions postures, fingering, and ornaments. Nevertheless, unlike C. P. E. Bach, Türk thinks the body position should be slightly higher, the thumb should be straight, and that other fingers should bend. (Türk, 1789) In Milchmeyer's book, on the subject of "performance posture", Milchmeyer mentions the position of the body, arms, hands and fingers, but does not mention the wrists. On the subject of "basic techniques", Milchmeyer introduces many playing techniques that include almost all the basic ones understood in his period. Finally, on the subject of "music theory", he summarizes and discusses musical expression in a whole chapter. One more significant consideration Milchmeyer notes is the concept of "Weight playing". (Milchmeyer, 1797) As we know, Isaac Newton provided his gravity theory at the end of the 17th century, and almost 100 years later, Milchmeyer mentions that the weight playing in his method involves using gravity in piano playing. Nevertheless, the weight school was established in the 19th century.

¹⁹ Daniel Gottlob Türk (1750-1813), a German composer, organist, and music professor.

²⁰ Johann Peter Milchmeyer (1750-1813) was a German court musician.

Therefore, it can be inferred that Michmeyer's weight playing is probably a precursor to the later weight school.

Here, I checked the contents of these method books and made *Table 1*²¹.

²¹ France (FR), Germany (DE), United Kingdom (UK), Czech (CZ)

Table 4.1

The summary of the 18th century's methods

	(FR) F. Couperin	(FR) J.-Ph. Rameau	(DE) J.S. Bach	(DE) C.P.E. Bach	(UK) J. Hook	(DE) D. G. Türk	(CZ) J.L. Dussek	(DE) J.P. Milchmeyer
Body position	○							○
Hand position and movement	○		○	○		○		○
Wrist-use	○							
Finger position and movement	○	○	○	○		○	○	○
Arm position and movement								○
Touch	○	○	○			○		
Scale	○			○	○	○	○	○
Arpeggio						○	○	○
Intervals (double-notes, octave)	○	○		○		○	○	○
Chords	○	○		○		○		○
Rhythm			○		○	○	○	○
Phrasing			○	○				
Ornaments	○	○	○	○	○	○	○	○
Fingering	○	○	○	○	○	○	○	○
Shake (Tremolo)								○
Pedal								○
Musical terms						○	○	
Note, Mark, Solmization	○				○	○	○	
Muscular, relaxation	○		○	○				○
Weight-use								
Sight reading						○		
Skeleton								
Memorisation	○							

*Made by the author

Piano pedagogy had plenty of creative developments in the 18th century. From *Table 4.1*, we can see that more pedagogies mentioned music theory, and the discussion of basic techniques was comprehensive. After the middle of the 18th century, intervals, chords, ornaments and fingering, scales, arpeggios, and pedalling were mentioned more frequently. That is because with the development of keyboard instruments, musicians could make more beautiful and subtle sounds. Therefore, more and more new techniques developed rapidly. Meanwhile, the innovation of keyboard instruments also brought a great deal of innovation to different aspects of pedagogy and led to keyboard instrument methods booming in the 19th century. Furthermore, only such as J. S. Bach and Couperin mentioned scientific conceptions in their methods. However, the situation was completely different in the 19th century.

4.2 Introduction to Piano Methods in the 19th Century

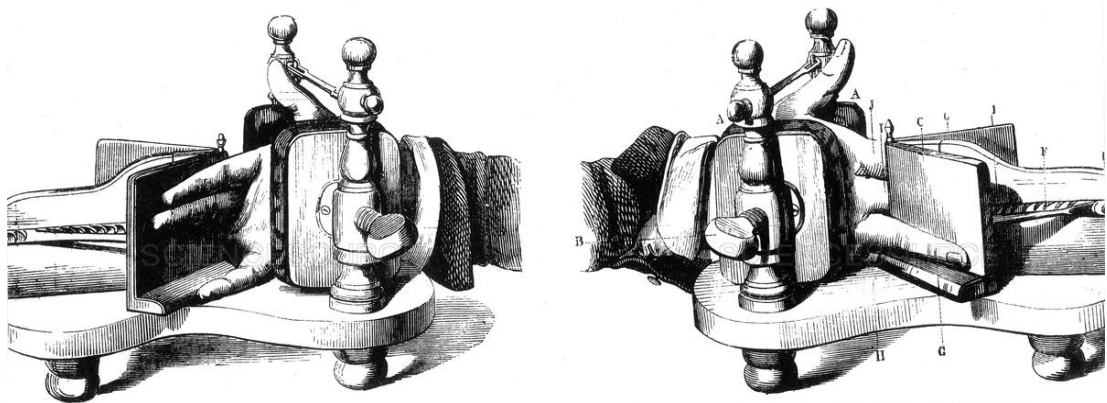
The most pivotal development in the 18th century was Bartolomeo Cristofori's invention of the pianoforte in Italy. The tremendous success of his piano is owed to its mechanism that produces the sound by striking strings with a hammer. Due to the piano's mechanical characteristics, it brought more possibilities to musicians. Thus, the piano instrument flourished from the late 18th century and was popularized from the 19th century. On the other hand, plenty of piano techniques arose to help musicians to show the piano's different kinds of sonorities, which in turn caused more and more learning methods to be

created. Piano learners had to learn more techniques they had never encountered before requiring more practice and guidance. Thus, as we can see, many new pedagogies and methods were produced in the 19th century. Simultaneously, several auxiliary devices were invented for practising with fingers, wrists, arms to help strengthen fingers and correct positioning. Among them, Chiroplast, Dactylion, and Digitorium achieved cult status during the 19th century.

Chiroplast is equipment to help beginners correct the position of hands, invented by Johann Bernhard Logier²² in 1814. (See *Figure 4.1*) Logier also wrote a method book *System der Musikwissenschaft* in 1827, which illustrated music theory and the principles of harmony.

Figure 4.1

Chiroplast



Source: New York Public Library / Science Source. Re: Chiroplast, Designed to Train Pianists. Retrieved from <https://www.sciencesource.com/archive/Image/Chiroplast-->

²² Johann Bernhard Logier (1777-1846), a German composer, educator, inventor and publisher.

Designed-to-Train-Pianists-

SS2607562.html#/SearchResult&ITEMID=SS2607562&POPUPPN=1&POPUPIID=2OPE

BMR87U1O (Accessed on Feb 13, 2021)

Dactylion is equipment to help strengthen and relax fingers, invented by Henri Herz²³ in 1836. (See *Figure 4.2* and 4.3)

Figure 4.2

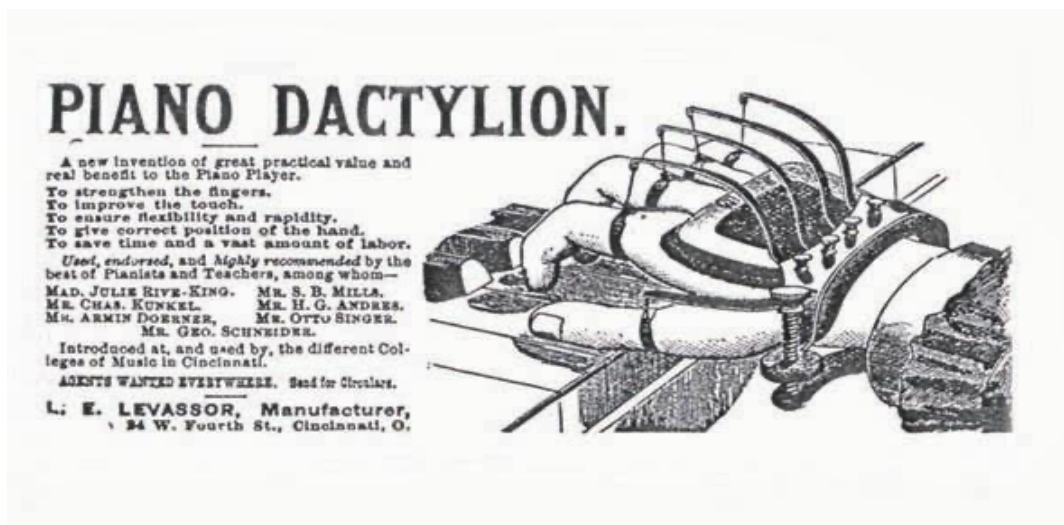
Dactylion (a)



²³ Henri Herz (1803-1888) a pianist and composer. He was born in Austria and moved to French.

Figure 4.3

Dactylion (b)



Source (Figure 4.2 and 4.3): Predota, Georg (2018, June 20th). Re: The Dactylion. Retrieved from <https://interlude.hk/dactylion/> (Accessed on Feb 13, 2021)

Digitorium, also called Dumb Piano, which strengthens and improves fingers' flexibility, was invented by Myer Mark around the middle of the 19th century.

(See Figure 4.4) The equipment was sold to amateur pianists.

Figure 4.4

Digitorium



Source: Museum of Applied Arts & Sciences (2001, Dec 1st). Re: Digitorium finger exercise machine. Retrieved from <https://collection.maas.museum/object/9739> (Accessed on Feb 13, 2021)

The three pieces of equipment above were the most popular physical exercise apparatuses during the 19th century. Beyond that, other exercise apparatuses had also been invented in this period, such as Hand-Guide, which Kalkbrenner invented; Brotherhood Technicon, which James Brotherhood invented for arm and wrist exercise; and Chirogymnast invented by Casimir Martin for improving hand control. However, everything has two sides. Although these apparatuses can help strengthen fingers and obtain good physical training, if players misuse them the opposite effect will occur. As we all know, Schumann got his finger paralysis because he overused a finger exercise apparatus Dactylion (Sams, 1971). Hence, one should not merely pursue results and blindly practice with the fingers.

Without awareness of physical and physiological principles, using those exercise apparatuses probably makes a player's hand or finger get irreversible damage, which once again proves that creating a reasonable, scientific method and pedagogy is urgently needed.

During the 19th century, sixteen representative methods were selected. They are the method of Muzio Clementi, Louis Adam, Gottlieb Graupner, Daniel Steibelt, Johann Nepomuk Hummel, Carl Czerny, Friedrich Wilhelm Michael Kalkbrenner, Frederic Chopin, Jean Théodore Latour, Franz Hüntten, Henri Herz, Henri Jerome Bertini, Charles Child Spencer, Nathan Richardson, Louis Plaidy, Theodor Leschetizky, and Ludiwig Deppe.

Clementi²⁴ starts with a brief music theory, and following that, he talks about integrated basic piano techniques. Concerning body position, it is worth mentioning that Clementi realised that when playing the piano, unnecessary motions should be avoided. (Clementi, 1803) This concept, which we call “economical playing” is very important in contemporary piano education because unnecessary motions need other muscles to work so that leads wrists or arms to get fatigued quickly. This is going to be discussed in Chapter V. In the end of the book, Clementi provided fifty preludes include his own pieces and works by other musicians such as Handel, Corelli, Mozart, Couperin, Pleyel, Dussek, Rameau,

²⁴ Muzio Clementi (1752-1832) was an Italian-born British composer, pianist, conductor music publisher and piano manufacturer. He most influenced Beethoven and Chopin.

Scarlatti, Cramer, Beethoven, C. P. E. Bach, and J. S. Bach, for helping students remember the keys. In addition, he completed an excellent work, *Gradus ad Parnassum*, in 1817. It includes one hundred etudes and covers all kinds of piano techniques at that age. (Clementi, 1803) Before Chopin's etude, *Gradus ad Parnassum* was called "Piano Techniques Encyclopaedia". He developed legato touch and influenced later musicians, especially Beethoven and Chopin. Also, his famous student, Johann Baptist Cramer, was influenced by him and took the technique of "legato" to a further step.

Cramer²⁵ does not leave any theoretical pedagogy works, but his piano studies and sonatas are a precious heritage in piano education. His famous study for piano is *Studio per il pianoforte* (also named *84 Études in Four Books*). Beethoven thought the etudes were an outstanding preparation before playing his sonatas, and Schindler even said that:

*Our master declared that Cramer's Etudes were the chief basis of all genuine playing. If he had ever carried out his own intention of writing a pianoforte method, the etudes would have formed in it the most important part of the practical examples, for on account of the polyphony predominant in many of them, he looked upon them as the most fitting preparation for his own works.*²⁶

²⁵ Johann Baptist Cramer (1771-1858) was an English pianist and composer. The disciple of Clementi.

²⁶ Schindler, Anton Felix. (1996) *Beethoven as I Knew Him*. North Chelmsford: Courier Corporation. P. 182.

According to Beethoven's statement, the *Studio per il pianoforte* inherited the polyphony of Bach and Scarlatti, and it profoundly influenced Chopin, Schumann, and Busoni. That is the reason we are still using his studies in piano education until today. Because of its guiding effect in history, I recommend practising *Studio per il pianoforte* during the primary stage of adolescent beginners' studies.

Louis Adam²⁷ cultivated lots of notable disciples, and the most famous one is Friedrich Kalkbrenner. I will introduce his pedagogy later. *Méthode de piano du Conservatoire* is Adam's important work which advanced piano techniques in France. At the beginning of the book, Adam (1804) discussed body position, and finger position and movement; significantly, he talked about the position of the thumb and little finger, and also discussed when one should use the arm. It is the first book I found that noted arm position and movement. Concerning arm position, he said:

*Tout mouvement des bras qui n'est pas absolument nécessaire est préjudiciable à l'exécution. On n'en peut admettre que de deux espèces ; l'un, lorsqu'on quitte le clavier pour observer les pauses ; l'autre, quand il faut porter la main de droite à gauche ou de gauche à droite pour prendre d'autres positions : l'avant-bras seul doit agir, la partie depuis l'épaule jusqu'au coude doit rester immobile.*²⁸

²⁷ Louis Adam (1758-1848) was a French composer, music teacher and pianist. He was a professor at the Conservatoire de Paris.

²⁸ Adam, Louis. (1804) *Méthode de piano du conservatoire*. Paris: L. Marchand. P. 5.

Adam mentioned that unnecessary movements of the arm should be avoided, and one can use the arm in the following two situations: 1) when fingers leave the keyboard to take a break; 2) when it is necessary to carry the hand from right to left or from left to right on the keyboard (Only the forearm should do the action; the part from the shoulder to the elbow must remain immobile). Additionally, he also elucidated basic piano techniques, and provided a comprehensive practice method for students. (Adam, 1804) According to Adam, awareness of muscle synergy and using body leverage are critical for efficient piano playing. On the other hand, Adam's methods were influenced by the thoughts of Couperin, which use more locomotive organs to play the piano.

Gottlieb Graupner's²⁹ method is similar to that of Clementi. He published a piano pedagogy, *Rudiments of the Art of Playing on the Piano Forte*, in 1806. However, this method is not his original method, which quotes the contents of earlier books written by Dussek and Clementi. Therefore, this method is an integrated pedagogy. Graupner took the core part of both pedagogies, which includes music theory, basic techniques, and especially the multiple types of scale practice (Graupner, 1806). The method of scale practice with two hands in contrary motion is mentioned for the first time in piano education history. At the end of the method, Graupner provided many practice fragments, including repeated notes, thirds, octaves, trills, and gave finger numbers for chords.

²⁹ Gottlieb Graupner (1767-1836) was a German born, American musician, educator, and publisher.

Besides that, he also wrote thirty lessons for finger practice with difficulty ranging from easy to hard, which appear to be based on Beyer's method. (Graupner, 1806) Overall, his method emphasised finger movements and provided a way to enhance finger functions and is an available method for late beginners.

Daniel Steibelt³⁰ talked about the advantages of the pianoforte at the beginning of his method. He suggested that beginners should first learn piano structure and play good sounds. (Steibelt, 1805) This method reveals that Steibelt wants to train students' solfeggio in the initial stage, and he thinks it is important. Steibelt then went on to discuss his method's approach to music theory. Next, he discussed posture. He emphasised hands position, how to move fingers and finger independence, and provided practice strategies for scales. At the end of the method, he mentioned some rules of finger position and utilization again. (Steibelt, 1805) Furthermore, he told us what the fundamental role of the finger is,

*Die ist die Sache der Finger, die durch die Tasten und die Hämmer die Seele des Komponisten und die Empfindungen des Spielers den Saiten mittheilen sollen.*³¹

³⁰ Daniel Steibelt (1765-1823) was a German pianist and composer. He studied music with Johann Kirnberger (the pupil of J.S.Bach) during his early life.

³¹ Steibelt, Daniel. (1805) *Méthode de piano*. Leipzig: Breitkopf & Härtel. P. 55.

He introduced a viewpoint well ahead of its time, which has influenced our modern scientific teaching methods,

*Man muss alles Unmaß vermeiden. Keine Steifheit, ein edler Anstand wird gefordert. Die erste schadet dem Ausdruck, die zweite verschönert. Der Lehrling merke sich folgende Regeln des Vortrages.*³²

Overall, this viewpoint is consistent with the modern economical and efficient piano method. In a profound sense, it tells students that they should just use the necessary muscles and pay attention to their body coordination. In other words, it focuses on muscle synergy and saving energy. In general, Steibelt's method emphasised reasonable finger use and advanced the scientific viewpoint in piano education, which provided more efficient practice methods for piano students.

Johann Nepomuk Hummel was an Austrian composer and pianist. When he was young, he studied music with W. A. Mozart. After that, he studied with M. Clementi and J. Haydn. Hummel can be called an Olympic trainer in the piano field because he cultivated many pianists and composers, such as S. Thalberg³³, A. v. Henselt³⁴ and C. Czerny³⁵. Also, he had a profound influence on the compositions of F. Chopin and R. Schumann. For example, the style of Chopin's

³² *Ibid.*

³³ Sigismond Thalberg (1812-1871) was a Swiss composer and pianist who was known during the 19th century.

³⁴ Adolf von Henselt (1814-1889) was a German composer and pianist.

³⁵ After studying with Beethoven, Czerny transferred to study with Hummel.

piano concertos was influenced by Hummel; in Hummel's piano sonata Op. 81, we can directly find the many factors that influenced the music of Chopin and Schumann. Hummel's music spans the classical and romantic periods. What is more, he worked under the guidance of masters in the classical period and profoundly impacted the compositional style of essential composers in the romantic period. Consequently, as far as I am concerned, his status is as important as Beethoven.

Before talking about Hummel further, as an aside it is worth discussing Henselt, an important student of his. Henselt profoundly impacted the music education world. Henselt taught piano in the Saint Petersburg Conservatory as the second director after Anton Rubinstein. His piano etudes were very popular at that time, and it was valuable to practice them before studying the etudes of Liszt and Chopin. Henselt's etudes include two works: Op. 2 "*Études Caractéristiques*" and Op. 5 "*Études de Salon*", altogether totalling twenty-four etudes, each piece with its own title. These etudes are not only for technical practice but also for studying musical expression. For these reasons, I recommend that each late beginner studies his etudes carefully. In addition, there are two famous second-generation pupils of Henselt: S. Rachmaninoff and A. Scriabin.

Hummel published *A Complete Theoretical and Practical Course of Instruction on the Art of Playing the Piano Forte* in 1828, which includes three

parts. It is a novel and comprehensive method book which impacted profoundly piano education at that time, and even now. This book includes a creative fingering system and combines practical practice with theoretical knowledge. At the beginning of Hummel's book, it is the first piano method book to mention what parents should do to help their children in piano learning, and to remark on what a qualified instructor should be like. Hummel said,

*Girls should not be taught music before 7 years of age, nor boys before 8; unless they should display a very remarkable degree of talent for it, and, in a manner, be led to it by the peculiar inclination arising therefrom.*³⁶

Therefore, we can see Hummel considered the beginning age according to the psychological problems of pupils and the situation of parents. This is advanced and innovative for his time.

In the following chapters, Hummel introduced posture; music theory including staves, clefs, notes, and music marks; also, he discussed fundamental techniques. When Hummel discussed time and beat, he used diagrams to show the relationship between time, beat, and hand movement. (Hummel, 1828) This is helpful to beginners for understanding beat intuitively and rapidly. At the end of Part I, Hummel wrote a supplemental chapter that selected past piano works for beginners (Hummel, 1828). This chapter has a special value as a reference

³⁶ Hummel, Johann Nepomuk. (1828) *A Complete Theoretical and Practical Course of Instruction on the Art of Playing the Piano Forte*. London: Boosey & Co. p. IV.

source for contemporary piano education and can help instructors choose the pieces for practice according to students' learning conditions. In Part II, Hummel elaborated a new system of fingering. He emphasised the importance of fingering:

*By Fingering is understood the correct and appropriate application of the fingers of both hands. This is founded on convenience, and neatness or elegance of appearance, on which again depends, in a great degree, precision and certainty of performance.*³⁷

Hummel (1828) also discussed thumb function and its importance within the ten divisions of his fingering system (Proceeding, Passage, Omission, Substitution, Extension, Usage of the thumb, Crossing, Changing, Placing, and Distribution). Finally, in Part III, he provided plenty of practical exercises that include various basic techniques for strengthening fingers, classified systematically.

To summarise, Hummel's methods influenced a number of notable pianists; even pianists such as Schumann and Liszt wanted to be his students. His method book mentioned above is the most complete and comprehensive book in the early 19th century. His method also informed my theory for adolescent beginners, which will be discussed in the next chapter.

³⁷ *Ibid.*, Part II, P. 1.

As one of the famous students of Hummel, Czerny³⁸ wrote a large number of piano pieces for finger practice. His works are well known to piano students and teachers around the world. We can learn techniques from Czerny's etudes and the basics of music texture and harmony. In piano education, Czerny cultivated many excellent musicians, such as F. Liszt and T. Leschetizky. I will talk about the method of Leschetizky in the following parts, and he proves that Czerny's piano pedagogy is indeed excellent.

In 1839, Czerny published one unprecedented a masterwork, *Complete Theoretical and Practical Piano Forte School, Op. 500*, which has three parts and contains almost all important elements in piano playing, including posture, all kinds of techniques, music theory, sight-reading, and score memorisation.

At the beginning of the book, Czerny shared his viewpoint on the appropriate age to begin piano,

*Much the greater number of those who begin to learn the Piano - Forte consist of children of from 8 to 10 years of age; and in truth we ought to commence as early as possible, if we wish to attain to any great degree of proficiency in playing.*³⁹

³⁸ Carl Czerny (1791-1857) was an Austrian composer, pianist and educator. He also studied with Hummel.

³⁹ Czerny, Carl. (1839) *Complete Theoretical and Practical Piano Forte School, Op. 500*. London: R, Cocks & Co. Part I, Op. I.

We can see that Hummel and Czerny each mentioned the starting age for piano at the beginning of their respective method books. According to Czerny's words above, we can find two things: First, people in the 19th century usually started to learn piano much later than contemporary students (which is consistent with what Hummel wrote). Second, Czerny realised piano study should start as early as possible rather than the later age popular at that time, which means he already found the differences between early beginners and late beginners.

In the first part of the book, Czerny focused on students' individual differences and put forward some advice for beginners in different stages. Then, he discussed posture and music theory, which he illustrated with musical examples. The second part contains fingering and includes practical examples. Finally, in the third part, he introduced musical expression; in other words, it tells students how to play music. (Czerny, 1839) Czerny's book is similar to Hummel's in the contents and structure, and we can see their methods fall within a heritage that progresses from Clementi to Hummel to Czerny. However, Czerny's method is more comprehensive and detailed. Furthermore, in the age of Czerny, the pianoforte had already come out. Therefore, we can infer that Czerny's method has more applicability today, and because of his understanding of individual and age differences, his etudes also can be used for adolescent beginners. However, instructors need to research again to find out which piece should be learned first, and which should be the next.

Kalkbrenner⁴⁰ was a pianist famous for his approach to touch, and he was a student of L. Adam. As a teacher, Kalkbrenner published his piano method *Méthode pour apprendre le piano à l'aide du guide-mains* in 1830. At the beginning of his book he introduced his “Hand-guide” used for finger practice, which is like Chiroplast invented by Bernhard Logier in the early 19th century. He said,

*Après mille essais infructueux, l'idée me vint, que tout ce qui tient au mécanisme du Piano pouvait être étudié à l'aide d'un moyen mécanique, qui donnât de prime abord aux mains leur véritable position.*⁴¹

He is probably the first person who proposed training fingers with an exercise apparatus in his method book, and he also designed the following method to relax the arm: Get an armchair, turn a chair arm towards the keyboard, pass the legs under this chair arm, sit down, put forearms on the chair arm, and play the piano (Kalkbrenner, 1830). This method can relax the forearm and the wrist and is based on a scientifically accurate understanding of the principle of leverage within the fingers and hands.

⁴⁰ Friedrich Wilhelm Michael Kalkbrenner (1785-1849) was a German born French pianist, composer, piano teacher and piano manufacturer. Chopin considered to become his pupil in 1831, but after his deliberations, he gave up. Kalkbrenner as a teacher was teaching in London and Paris.

⁴¹ Kalkbrenner, Friedrich Wilhelm Michael. (1830) *Méthode pour apprendre le piano à l'aide du guide-mains*. Paris: Chez I. Pleyel et Cie. P. 3, Préface.

In the following chapters, Kalkbrenner briefly illustrated music theory and six basic piano playing techniques; he also advocated using more pedals to make different sounds, which is reflected in his exquisite key touch (Kalkbrenner, 1830). Even Chopin paid his enchanting key-touch extravagant compliments. Actually, Kalkbrenner wanted Chopin to be his pupil, but unfortunately, Chopin did not like the comments from Kalkbrenner about himself because Kalkbrenner said Chopin's style was like Cramer and his touch close to Field (Hedley, 1962). Naturally, Chopin did not like the comments; thus, Chopin refused Kalkbrenner's invitation.

As we all know that Chopin was a virtuoso pianist and composer, he also contributed to piano education, and his methods are worth examining. According to Eigeldinger (1986), Chopin emphasised that hands and bodies should keep softness and suppleness, which is a fundamental principle for each piano student. He insisted that the wrist and arm will naturally acquire softness when the hand becomes relaxed and supple. He considered physical exercise for relaxing the wrist necessary, and his exercise involved stretching the wrist repeatedly. Regarding arm and elbow movement, Chopin suggested dropping the fingers freely, and fingers actively lead arm movement. Meanwhile, the player should avoid the help of arm weight. Chopin thinks this exercise also can improve finger independence. Besides, Chopin focuses on key-touch identical to Kalkbrenner. Therefore, while he is opposed to the old school view that finger strength should be practised equally, he posited that the characteristics of each finger should be

preserved. He thought this is important in finger independence exercise. On the other hand, Chopin guided students practise scales starting from B major, then according to the decrease of the key signature, practise C major at last. And Chopin suggested students practise scales in staccato. He thought exercises alternating between staccato and legato can improve accuracy because of muscle memory. After the scale practice, students were required to practice arpeggios and chromatic scales. Furthermore, Chopin urged his students to study music theory as early as possible. (Eigeldinger, 1986)

From the above, Chopin's extraordinary methods encourage students to practice the piano with more logical and reasonable strategies and to heed essential physiological characteristics of fingers. However, his perspective on using arms seems to be still conservative until weight-touch school establish. Nevertheless, it can still be seen that Chopin utilised hand weight in his key touch.

Additionally, Chopin's educational repertoire is also worth considering for adolescent beginners. This is because most of the piano beginners among Chopin's students were not children. *Table 4.2* summarises the works that Chopin recommended his students to study (Eigeldinger, 1986).

Table 4.2

The works that Chopin recommended his students to study

Composer	Work
	Solo
J.S. Bach	•The Well-Tempered Clavier
M. Clementi	•Preludes and Exercises, Op. 43 •Gradus ad Parnassum, Op. 44
J.B. Cramer	•84 Etudes
I. Moscheles	•Charateristic Studies, Op. 95
J.N. Hummel	•La Bella Capricciosa, Op.55 •Piano Sonata No. 5, Op. 81
L.v. Beethoven	•Piano Sonata Op. 14/2, 26, 27/2, 57
C.M.v. Weber	•Piano Sonata Op. 24, Op. 39 •Aufforderung zum Tanze, Op. 65
F. Schubert	•Waltzes, Ländler and Ecossaies
F. Mendelssohn	•Song Without Words
	Four-Hands
F. Schubert	•Three Marches Militaries, D. 733 •Polonaises •Divertissement à la hongroise, D. 818
I. Moscheles	•Grand Sonata, Op. 47 •Rondo brilliant for Piano Four-Hands, Op.30
J.N. Hummel	•Grand Sonata, Op. 92 •Nocturne for Four-Hands, Op. 99 •Sonata for Four-Hands, Op. 51

Note: According to Chopin's pedagogies and his pupils, the works that Chopin chose and used for late beginners have been summarised. (Made by the author)

From *Table 4.2*, we can see that Chopin mostly focused on works with cantabile and modulations. Significantly, in such works as Moscheles' and Hummel's, the player should sing the melody and simultaneously think about modulations and finger movements. Furthermore, as we all know, Bach also plays an essential role in piano pedagogy. However, Chopin and Bach have some divergent opinions concerning fingers. While Bach thought five fingers should

obtain equal practice, Chopin thought each finger's unique qualities should be preserved (Eigeldinger, 1986). On this point, I recommend that all adolescent beginners pay attention to finger features and do not pay too much attention to finger-strength training. After all, the source of finger strength is arm muscles, which has been mentioned in Chapter II.

In addition, Chopin taught his primary level students using Clementi's *Preludes and Exercises, Op. 43* and *Gradus ad Parnassum, Op. 44*, particularly the Op. 43, and he first used songs with many key signatures like B major or D^b. Then he guided students into Cramer's *84 Etudes* and Bach's *The Well-Tempered Clavier*, as well as the *Characteristic Studies Op. 95* of Moscheles. Chopin thought that the works of Clementi, Bach, Hummel and Field are the best choice for beginners, and Chopin thought that as long as their works are learned well, his own works can be learned as the next step (Eigeldinger, 1986). Consequently, Chopin's pedagogy discussed above can be a reference for instructors when teaching late beginners.

So far, among the method books mentioned above, we can find more and more attempts to combine music theory and practical exercises. As Latour⁴² said in his method book *New and Improved Method of Instruction for the Pianoforte*, there is a fundamental fault that music theory and practice are not sufficiently

⁴² Jean Théodore Latour (1766-1837) was a French pianist and composer. He wrote some piano sonatinas for beginners and other several works be included in the books for students.

combined in piano education, which has caused many conceptional troubles for learners, so that it is hard to practice the piano (Latour, 1832).

Latour explained that basic music theory includes notes, staves, clefs, time, rests, and sharp and flat marks in the first part of his method book. Also, he pointed out correct posture and supplemented a system of scale preparation exercises. In the section on posture, Latour said that the distance from the piano should keep the length of an arm and mentioned the position of the wrist. Remarkably, he proposed a revolutionary concept: players should keep knuckles flat on the keyboard. Moreover, he added that the three long fingers (index, middle, and ring fingers) should be bent slightly while the little finger must be straight. (Latour, 1832) Before Latour, most methods recommended that students curve their knuckles and the little finger. However, after Latour, more and more pianists and educators realised that bent fingers and flat knuckles should be used together.

Part II is devoted to lessons and exercises. Latour wrote fifty-four lessons for scale practice; however, all exercises' key signatures containing no more than three sharps or flats. We can find that Latour's lessons make it difficult for beginners to learn scales and arpeggios, because according to Chopin, the more black keys, the more natural the hand position. Besides scales and arpeggios, there are some lessons for practising triplets, Alberti bass, octaves, and intervals (thirds). The pieces in Latour's lessons include simple harmonies. Furthermore,

all the lessons have common point, which is that they are integrated with explanations of music theory. At the end of Latour's method book, he adds a list of musical terms. (Latour, 1832) Although Latour's method seems not to be mentioned frequently in history, his contributions, the flat knuckles and the combination of practice and music theory in piano playing, influenced subsequent methods.

The following method I want to discuss is *Méthode de piano*, written by Franz Hünten⁴³. The structure of this method is similar to Latour's, including fundamental music theory and plenty of lessons for practising basic techniques.

At the beginning of the method, Hünten introduced elementary music theory, which is divided into two sections: "The principle of key touch" and "The advice for learning piano". In the first section, Hünten emphasises that students should understand the mechanics of fingers, that their movements should be independent, and that the use of the wrist and arm is forbidden. Moreover, he suggests one should be cautious about putting weight on fingers to ensure good sound. Besides, Hünten said the fingers should stand on the keys, and the movement of the hand should be as small as possible. (Hünten, 1833) These measures not only ensure correctness but also achieve the goal of "Economical Playing". Furthermore, this reveals that Hünten utilised gravity and had discovered weight playing.

⁴³ Franz Hünten (1792-1878) was a German pianist and composer.

In the second section, Hünten provides some advice for piano practice. He thinks the minimum practice time is three hours a day. He recommends dividing the three hours into three practice sessions within a day and keeping sufficient hand rest before and during practising, rather than practising continuously for three hours without resting hands. Moreover, five fingers should be practised in the first one hour, then the pieces arranged by teachers or other pieces can be practised in the next two hours. (Hüntén, 1833) Because the piano cannot sustain sounds produced by a single keystroke, polyphonic music should be carefully practised; slow practice while counting beats is necessary. After the slow practice, instructors need to choose an appropriate tempo for students, and the piece should be played with fewer unnecessary motions of the hand in the tempo. Also, single hand practice is necessary.

At the end of this part, Hünten deplored that many students like to choose pieces that are too difficult to play for their actual abilities. Choosing a piece should be based on the actual learning conditions, abilities, and even the physiological conditions of students. Hünten thinks that even in one easy piece, some parts are challenging and worth practising. (Hüntén, 1833) Therefore, I think repertoire should not be complex but exquisite, and before students obtain a real proficiency in piano playing, earnest practice and a positive learning attitude should become a habit. Do not be in a hurry to succeed.

In the latter half of the method, Hüntén provides several lessons titles indicating their practise purpose (Hüntén, 1833). In contrast with the method of Latour, Hüntén's lessons are without any music theory statements. However, Hüntén gives students lots of suggestions with practical significance, and they are worth being used for reference. Hüntén's methods were inherited by Henri Herz, the son of Hüntén's teacher Daniel Herz.

Herz wrote a method book called *New and Complete Piano-forte School*⁴⁴. The book consists of two parts: fundamental music theory and techniques. The method book includes some of Herz's suggestions for piano practice and study strategies. Moreover, Herz invented a device for fingers exercise, which is Dactylion that I mentioned above.

At the beginning of the method, Herz emphasises the importance of rhythm and explains the definition of melody and harmony; then, he talks about music theory starting from musical notation. (Herz, 1844) Herz places great emphasis on notation because understanding notation is necessary for fluent score reading. Moreover, just as languages have their vocabularies, music as a language also has its vocabulary, which consists of notes.

⁴⁴ The original edition is written in French *Méthode Complète De Piano*, the first version is published at Mainz by the publisher B. Schott's Söhne in 1838.

Before discussing techniques, Herz introduces the features of piano structure and how to choose piano. Next, posture and motion of hands are discussed. He mentions that the right foot should be put on the damper pedal, which no person has mentioned before. Also, Herz thinks that hands should be rounded, fingers should be bent, and each finger must have an independent motion; in particular, Herz realised that hands could not keep the same position while playing; thus, he gives two ways to help change hand positions: (Herz, 1844)

*1. by lifting off the hand entirely, in order to transport it from right to left, or from left to right; 2. By passing the thumb rapidly under the fingers, or the fingers over the thumb.*⁴⁵

In the next part, Herz considers several music terms that are often used in daily practice and provides some suggestions for young pianists:

*Perseverance and a love of his art are, for a young artist, indispensable requisites of success... Patience and continued labor will never lead to superiority, unless enlightened by a sound judgement and directed by a rational method.*⁴⁶

Indeed, as the old saying goes in China, “Interest is the best teacher”. Interest can stimulate the learning impetus, and it will help students stick to learning. However, it is difficult to improve learning efficiency if there is only simple patience and continuous efforts but no feedback from others. Constructive

⁴⁵ Herz, Henri (1844) *New and Complete Piano-forte School*. John F. Nunns, 240 Broadway. p. 11.

⁴⁶ *Ibid.*, p. 16.

criticism will give students confidence, constantly stimulating their fighting spirit and guiding them to pursue higher goals. Moreover, it reveals the relationship between piano learning and the mental characteristics of adolescent beginners, which I have mentioned in Chapter II. And we can find that Herz has realised the psychological influence on piano practice.

Herz also gives young students suggestions about time allocation for practice. He thinks young students need to practise the piano four hours per day. In the first hour, students should exercise with Dactylion and practice scales and other basic techniques according to the method book; in the second hour, students can practice the pieces they are learning or something new; in the last two hours, students need to review the pieces they have practised. (Herz, 1844) Herz's time allocation is different from Hüntens'. Herz adds a physical exercise and requires a review. However, they both mention that break time during practice is needed to avoid hand and finger fatigue.

Furthermore, Herz (1844) advises students on how to learn a new piece. Here are his steps: 1) Find the best fingering, especially in difficult passages. Then after practicing with a single hand, take a slow tempo to find a proper balance in both hands; 2) Do not practise the piano mechanically – you should think of finger motion and feel the sounds you hear; 3) Analyse the music to find its character and peculiarities. This will help you play more easily and improve accuracy; 4) When you are done with the piece, it is necessary to review it after

a period of time (p. 17). At last, Herz says it is helpful to play some works for four hands or two pianos; they can help learn and practice harmony. Also, students should aspire to play longer, monumental works. (Herz, 1844) From above, we can see that the mental practise in Herz's second step is consistent with modern methods. In addition, in Herz's fourth step concerning ensemble practice, I think Chopin holds the same viewpoint as Herz.

In the last part of the method book, Herz provides many lessons for exercising the five fingers, and he requires that while students are practising these lessons, they should practise Dactylion together. (Herz, 1844) Overall, his lessons are similar to Hanon's *The Virtuoso Pianist in 60 Exercises*⁴⁷, which systematically lists all kinds of basic techniques and exercises in unison playing by both hands; as well as Liszt's finger exercise *Technische Studien, S.146* published in 1886, which includes exercises to improve finger independence and strength, and to enhance playing abilities with scales, arpeggios, and other techniques. However, Liszt's studies are comparatively challenging to practise. Furthermore, each of Herz's lessons offers playing advice and explains music theory and are similar to Hüntten's lessons (Herz, 1844). At the end of his book, Herz (1844) attaches twelve short elementary lessons which include works of composers such as Carafa, Puget, Adam, Mozart, and Bellini, and other works

⁴⁷ Charles-Louis Hanon (1819-1900) was a French piano educator and composer. He published his famous work *The Virtuoso Pianist in 60 Exercises* in 1873, it is now practiced popularly among piano beginners around the world.

representative of various genres, including Russian air, Rondo, Nocturne (Bellini), Variations (Donizetti), Bagatelle (Ricci), Amusement (Donizetti), and 18 Characteristic Studios (Herz). (pp. 19-20)

The method of Herz discussed a comprehensive piano method. It includes two advanced conceptions, using finger physical exercise equipment Dactylion and psychological pedagogy for learning piano, which has contributed to the novel piano methods. Therefore, it is worth referring to in my study.

The next book we will examine is *Progressive and Complete Method for the Pianoforte*⁴⁸ by Henri Bertini⁴⁹, who was a pupil of Clementi. At the beginning of the method, two pictures show the hand position and body posture. Two pictures depict the hand bent into the shape of an arch, and the upper body held erect. Below the illustration, Bertini says this ridiculous appearance should be avoided (Bertini, 1848).

The next part is the *Preface*. Bertini points out that most methods neglect to include a systematic presentation of the mechanics of piano playing from the outset. He thinks the first lesson should carefully guide to students because if students acquire a fault, it will accompany them forever. He found that even some students still feel reading the score is difficult, despite having learned piano for

⁴⁸ The original edition is written in French *Méthode Complète et Progressive de Piano*, published at Paris by Schonenberger publisher in 1840.

⁴⁹ Henri Jerome Bertini (1798-1876) was a French pianist and composer.

years. (Bertini, 1848) Unfortunately, this awkward situation still exists today, as shown in Chapter III. One reason is, probably the way that the piano education separated music theory and piano practising, which Latour (1832) considered an essential fault. Moreover, Bertini gives some advice for piano practice, especially concerning the use of wrists and forearms:

The touch should be given exclusively from the fingers in skills, in runs of the scales, and in other running passages... The keys should be struck from the wrists in chords and octaves, in lively and light movement... And in a moderate movement, where the expression demands great force, the keys must be struck from the fore-arm.⁵⁰

Bertini sees the fingers, hand, wrist, and forearm as one coordinated locomotive organ, and this is a scientific perspective related to kinematics.

Bertini also suggests that students practice scales first, then gradually speed the tempo until they reach maximum velocity. Therefore, he wrote a series of systematic, comprehensive scales exercises, including all majors and minors. For each key he provides a typical scale exercise, a piece written in one genre (such as an aria or waltz), and a study containing scales and various basic techniques. He also includes several works for four hands. Each scale is presented with Bertini's comments. (Bertini, 1848) We have seen that Chopin and Hüntten both gave supplementary four-hands works in their pedagogies. Furthermore,

⁵⁰ Bertini, Henri Jerome. (1848) *A Progressive and Complete Method for the Piano-forte*. Boston: New England Piano Co. p. IV.

exercises for arpeggios, broken chords, chromatic scales (in thirds, sixths, and octaves), scales in thirds, and octaves are included as well.

Additionally, Bertini emphasises the importance of rhythm. He recommends counting beats simultaneously while practising the piano. At the end of the book, Bertini suggests that works from the old schools of Italy and Germany should be learned well to cultivate students' personalities and styles. He recommends a few composers, such as Haydn, Mozart, Clementi, Dusek, Cramer, Beethoven, and Hummel. (Bertini, 1848)

Throughout the book, Bertini discusses his methods centred on music theory. Therefore, we can say that Bertini is a fellow traveller of Latour and Herz. However, his explanation is more systematic and independent. Let us see his catalogue. (See *Figure 4.5*)

Figure 4.5

Contents from Bertini's method book

CONTENTS.	
PAGE.	PAGE.
APPOGGIATURA (Exercise on the Appoggiatura for both Hands),.....	52
ARPEGGIOS IN THE HARP STYLE, with Exercises in Arpeggio Chords,.....	60
ARPEGGIOS (Exercise in Arpeggios, with Small Notes ascending),.....	72
ARPEGGIO CHORDS (Exercise in Arpeggio Chords),.....	132
CHANGING OF THE FINGERS ON THE SAME NOTE,.....	123
CHANGING OF THE HANDS (Exercise for the changing of the Hands),.....	151
CHORDS (Exercise on Chords),.....	44
CHORDS (Exercise on Chords of the Seventh in all its Positions),.....	66
CHORDS (Exercises on Chords),.....	175
CHORDS (Exercise on Chords extending to Ninths and Tenth),.....	180
COMMON CHORDS (Fingering of Common Chords in the Three Positions),.....	179
CROSSING OF THE HANDS (Exercise on crossing of the Hands),.....	49
CHROMATIC SCALE,.....	83
CHROMATIC SCALE IN CONTRARY MOVEMENT,.....	89
CHROMATIC SCALES (Exercises in Chromatic Scales, with Double Notes),.....	147
CHROMATIC SCALES (Exercises in Chromatic Scales in Sixths for both Hands),.....	161
DAILY STUDY OF THE MAJOR AND MINOR SCALES,.....	75
DICTIONARY OF MUSICAL TERMS,.....	192
DOT (Explanations on the Dot),.....	9
DOT (Lesson showing the use of the Dot),.....	12
DOTTED HALF-NOTES (Exercise on Dotted Half Notes),.....	17
DOTTED NOTES (Exercise on Dotted Notes),.....	42
DOUBLE NOTES (Exercise on Double Notes of Different Intervals),.....	153
EMPLOYMENT OF THE THUMB ON TWO NOTES STRUCK AT THE SAME TIME,.....	181
EXERCISE FOR PASSING THE LEFT HAND OVER THE RIGHT,.....	68
FINGERING OF ALL THE COMMON CHORDS, AND THEIR INVERSIONS IN ARPEGGIO MOVEMENTS, MAJOR AND MINOR,.....	62
INTRODUCTION TO THE STUDY OF THE SCALES, WITH REMARKS,.....	38
KEY-BOARD (Preparatory Exercise for placing the Hands on the Key-board),.....	2
KEYS (Exercise in all the Keys),.....	68
LIGHTNESS (Exercise on <i>Leggiero</i> , or Lightness),.....	110
MEASURE (Preliminary Exercises on the Measure),.....	7
MELODY FOR FOUR HANDS,.....	36
MELODY FOR FOUR HANDS,.....	58
MELODY FOR FOUR HANDS,.....	86
MELODY FOR FOUR HANDS,.....	112
NOTES, STACCATO (Exercises on Staccato Notes),.....	21
NOTES, STACCATO (Exercises on Staccato Notes),.....	91
NOTES (On Value of Notes),.....	11
NOTES (Exercises in repeated Notes, with Changes of the Fingering),.....	31
OCTAVES (Exercises in Octaves),.....	164
OCTAVES (Exercises in Octaves, broken),.....	171
PREFACE,.....	IV
RHYTHM (Exercise on Rhythm),.....	10
RHYTHM (Exercise on Rhythm),.....	16
RHYTHM (Exercise on Rhythm),.....	18
RHYTHM (Exercise on Rhythm),.....	23
SCALES, WITH REMARKS,.....	38
SCALES (CHROMATIC), IN CONTRARY MOVEMENT,.....	89
SCALES IN THIRDS,.....	142
SCALE (CHROMATIC), IN SIXTHS, FOR BOTH HANDS,.....	161
SCALES DIVIDED (Daily Study),.....	191
SIXTHS (Exercise in Sixths),.....	158
SIXTHS (Exercise in Sixths, broken),.....	162
SLUR AND TIE (Exercise showing the Use of the Slur and Tie),.....	13
STACCATO NOTES (Exercise on Staccato Notes),.....	21
STACCATO NOTES (Exercise on Staccato Notes),.....	91
SYNCOPIATION (Exercise on Syncopation),.....	19
SYNCOPIATION (Exercise on Syncopation),.....	113
THIRDS (Exercise on Thirds for both Hands),.....	149
THIRDS (Exercise on Thirds, broken),.....	155
TIE AND SLUR (Exercise showing the Use of the Tie and Slur),.....	13
TIME (Explanation on the Division of Time),.....	7
TRIPLETS (Exercise on Triplets),.....	28
TRILL (Preparatory Exercises on the Trill),.....	54
TRILL (Preparatory Exercises to the Study of the Trill),.....	109
TRILL (Exercises and Illustrations on the Trill),.....	114
TRILLS (Exercises and Illustrations in the Trills most used),.....	115
TRILL (Study of the Trill),.....	184

Source: Bertini, Henri Jerome. (1848) *A Progressive and Complete Method for the Piano-forte*. Boston: New England Piano Co. CONTENTS.

We can find that Bertini's method is organized and logical. The method is sectioned into types of techniques and is classified according to major and minor keys. On the face of it, the structure and contents seem similar to Hanon's method. However, as my analysis above shows, because Bertini's method includes

different genres of piano pieces, especially four-hands works, the students will not find it too dull when practising technique. Also, this proved once more proves the importance of music theory. Consequently, Bertini's method book is a worthwhile resource for late beginners. A similar method book I found is written by Charles Child Spencer.

Charles Child Spencer⁵¹ wrote a method book, *The Rudiments of the Art of Playing the Pianoforte*, which focuses on fingering from a unique perspective. In this method, Spencer follows the British pedagogical style that counts fingers from the index finger, which means that the index finger will become the first finger, the middle finger is the second, the ring finger is the third, and the little one is the fourth. I think this is because Spencer is concerned about the difference between the thumb and other fingers. It reminds me that before Bach, the thumb was rarely used in keyboard music. The following exercises from his method book reflect the thumb's special role in piano playing. Therefore, they afford a special opportunity for late beginners to better understand each finger's characteristics under the instructor's guidance.

Concerning the keystroke method, Spencer provides the prototype of the method that we are now familiar with. He writes,

⁵¹ Charles Child Spencer (1797-1869) was a British writer and composer. He has written many method books include musicology, composition and piano.

... Raise the whole hand about an inch above the keys, keeping each finger in the line with its key, not stiffly but loosely, so as to allow it to move downward from this height, and to press down the key appropriated to it... by degrees, the stiffness will go off, and the motion will become easy...⁵²

Spencer's keystroke method is similar to the method of Martin Hughes⁵³. Prof. Hughes suggested a way to practice keystroke: place the forearm on the table and then prop up the third joints (MCP) to form an arch of the whole hand. At this time, the fingers need to be straight, and the wrist cannot leave the table. Then, raise fingers in turn, drop them down loosely without stiffness. This method helps students learn how to support their hands and use fingers, because an arch-shaped hand is the most stable, flexible form, and makes it easy to play with weight (weight touch). I will discuss it in the next chapter in the part about the "hand-bridge". Prof. Hughes taught this physical exercise to every student so that they could do the practice anywhere. I think this method is instrumental for helping adolescent beginners understand finger use more quickly.

Moreover, Spencer also suggests that students put five fingers on the keyboard and play from C to G. (Spencer, 1853). Thus, combining physical and practical training can help students understand the essentials of keystrokes and

⁵² Spencer, Charles Child. (1853) *The Rudiments of the Art of Playing the Pianoforte*. London: John. Weale. pp. 3-4.

⁵³ Martin Hughes is a British pianist, pupil of Yvonne Lefébure, Benjamin Britten, Lev Oborin and Wilhelm Kempf. The author had piano lessons with Martin Hughes during 2015-2019, and author also has helped translate many Prof. Hughes's lessons for other non-English speaker students.

guide students to use their fingers correctly. Moreover, scientifically, a solid foundation of hand and finger use lays the base for later exercises. In addition, this practical exercise is considered to be a possible predecessor of Hanon's method.

In the following parts of Spencer's method, almost every explanation of playing skills is based on fingering. Spencer suggests studying fingering with each hand separately. Furthermore, Spencer discusses each technique with an explanation of the underlying music theory. He discussed the fingerings of scales (including chromatic scales) and summarises fingering's manners; (Spencer, 1853) these are almost inherited from previous methods. In addition, he provides three primary requisites in performance:

1. *The correct reading of the notes.*
2. *The employment of the correct fingers.*
3. *The assignment to each and every note its exact portion of time.*⁵⁴

The three requisites condense Spencer's main concerns: students need to learn basic music theory well according to the first requisite; the second requisite prompts students to think about fingering rules according to the last part of Spencer's method book; the third requisite requires students to divide the rhythm into small segments and count them carefully. Moreover, Spencer's three basic

⁵⁴ Spencer, Charles Child. (1853) *The Rudiments of the Art of Playing the Pianoforte*. London: John. Weale. p. 20.

requirements are all based on music theory. Additionally, Spencer listed types of rhythms with detailed examples and analyses fingering to help satisfy the third requisite in his book. And he gives some short etudes written by himself at the end of this part. (Spencer, 1853) Spencer's method overall is challenging for children because it includes abundant theoretical knowledge and complex, challenging practice contents. However, for adolescent beginners whose understanding and cognitive abilities are higher than those of young children, it could be not only a systematic, comprehensive method but also it is a valuable rhythm training method.

In the following chapters, Spencer discusses the fingering problems of the third and the sixth intervals and mentions that the fingerings could be slightly changed for different sizes of hands (Spencer, 1853). Apparently, Spencer accounted for individual differences; unfortunately, this awareness is rare in past methods.

On the other hand, according to the questionnaire research from Chapter III, hand jumping is considered a problematic technique for early beginners, and even for late beginners and piano major students. In Spencer's approach, he advises how to practice skips within an octave,

... it becomes necessary to change the position of the hand altogether. But within the limit of an octave, the passage in skips may be performed without changing the position of the hand. The best way is to place the fingers over

*all the notes within this limit, the same as if we were required to strike them all together, observing which fingers would be most convenient for such purpose.*⁵⁵

Here Spencer considers two kinds of skips: one is beyond an octave, and the other is within an octave. Thus, he gives a playing method: put the fingers on the keys and then play the notes together to find the correct hand position. Additionally, for skips beyond an octave, Spencer also discussed how to determine the fingering and wrote many short exercises for the practicing skips beyond an octave (Spencer, 1853). These exercises will help students better understand how to position their hands and know the relationship between fingers, wrists, and arms. This is the way I usually see technique presented in a modern piano method. In fact, it is a method to practice the coordination of locomotive organs.

Among the methods I studied, the British methods are unique and novel. Under Spencer's detailed theoretical explanation, I believe many late beginners can better understand the techniques of piano playing. Spencer's book discussed how to use hands reasonably according to performance and music needs. It should depend on the music to express the sounds and imagine the player's desire using different hand positions or movements. Therefore, it is considered important to consider music instead of hand and finger movements at first.

⁵⁵ Spencer, Charles Child. (1853) *The Rudiments of the Art of Playing the Pianoforte*. London: John. Weale. p. 76.

The next one I want to introduce is also a representative method book from Britain, *New Method for the Piano-forte*, written by Nathan Richardson⁵⁶. He was a pupil of Meyer, Moscheles, and Dreyschock⁵⁷. At the beginning of the book, Richardson (1859) illustrates piano playing posture, and the illustrations are based on adults rather than children. In the discussion of posture, Richardson shows more attention to thumb use. He realised the differences between the thumb and other fingers. Moreover, in the discussion of scale practice, he introduces how to use the thumb and also provides some Etudes for its practice.

*The great difficulty in playing the Scales is in passing the thumbs under the fingers, and the fingers over the thumbs in a smooth and undetected manner... In order to overcome these difficulties, it requires a certain kind of practice to make the thumb joints flexible.*⁵⁸

However, Richardson does not describe how thumbs work in executing that movement (Richardson, 1859). As a matter of fact, I also find that many students have such problems. When their thumbs are passing under the fingers or other fingers over the thumbs, the motions are not natural and smooth, and they like to turn their elbows out to help fingers over thumbs. From the physics viewpoint, when the fingers are over the thumb, the thumb should be regarded as an axis of rotation; when the thumb passes under the fingers, the second or the third fingers

⁵⁶ Nathan Richardson (1827-1859) was a piano educator and music writer.

⁵⁷ Alexander Dreyschock (1818-1869) was a Czech pianist and composer.

⁵⁸ Richardson, Nathan. (1859) *New Method for the Piano-forte*. Boston (UK): Oliver Ditson & Company. p. 43.

should be an axis. At this point, we need to find more modern scientific evidence to improve the effectiveness.

Richardson's book is based on five-finger exercises and includes the explanation of music theory. It is similar to Spencer's book, but Richardson understands better the importance of five-finger practice. His suggestions on five-finger exercises are as follows:

Practice with each hand separately at first and very slowly. Raise the fingers high, and strike with a firm blow... Be careful to strike the notes with equal force. Avoid all stiffness...

...It should be the first morning exercise of advanced players to play five finger exercises...

...the pupil cannot give too much time to the practise of them, as they give equal strength to the fingers, and form an elegant touch, which is so requisite to a fine performance...⁵⁹

In Richardson's five-finger exercises, most of them help train the independence of fingers, especially exercises No. 29, and 34 ~ 36 (Richardson, 1859), which are similar to Liszt's finger exercises, and involve holding one or three keys and play different types of notes with the remaining fingers. It significantly improves finger independence, but if students practise those exercises incorrectly, it will

⁵⁹ Richardson, Nathan. (1859) *New Method for the Piano-forte*. Boston (UK): Oliver Ditson & Company. p. 27, 30, 36.

cause irreversible damage to the fingers according to the anatomical analysis of Chapter II.

Late beginners can learn theoretical knowledge from Richardson's method. Concerning Richardson's method of learning music theory, he suggests that students should try to practise works written using only the treble clef or bass clef staff with both hands after learning the staff. Students need to pay attention to the fingerings during the exercise and try to keep their eyes on the notes instead of the keys as much as possible (Richardson, 1859). This kind of practice is intended to cultivate a spatial sense of the keyboard, and it can improve the speed of score reading as well. Richardson emphasises the importance of ears, especially for beginners, and he also suggests counting the beats during practice (Richardson, 1859). He says, "*never begin a piece quicker than you can with certainly go through it to the very end.*"⁶⁰ Therefore, we can determine the whole piece's tempo through the tempo you can play in the most difficult parts. In addition, Richardson also advises on the allocation of time for piano practice: two or four hours a day, which should be divided into different parts of the day (Richardson, 1859). It is the same as the previous methods. Moreover, he provides a detailed method of allocating time:

⁶⁰ Richardson, Nathan. (1859) *New Method for the Piano-forte*. Boston (UK): Oliver Ditson & Company. p. 60.

*...the pupil dedicates it daily, but three hours only, of which about half an hour shall be appropriated to the Exercise, as much more to playing over the old pieces, and the remaining time to the study of new compositions...*⁶¹

In the second half of the 19th century, a great piano educator, Louis Plaidy,⁶² trained many famous composers and pianists, such as Hans von Bülow and Edvard Grieg. Additionally, he is famous for his piano pedagogy. Plaidy wrote a method book, *Technical Studies for the Piano*, and he left lots of piano studies, which are still occasionally used today.

A contemporary British pianist, Nick van Bloss, started learning piano at around eleven years old. He strongly recommends that students solve piano playing problems using Plaidy's method; and Nick thinks Plaidy's exercises are beneficial to fingers and do not easily cause injuries. For Nick himself, he thinks these exercises are efficient. Nick also mentions two famous pianists, Rosina Lhévinne⁶³ and John Browning⁶⁴, both of whom inherited the methods of Plaidy.⁶⁵ As an early-adolescent beginner, Nick has grown up to be a concert

⁶¹ *Ibid.*, p. 150.

⁶² Louis Plaidy (1810-1974) was a German well known piano teacher.

⁶³ Rosina Lhévinne (1880-1976) was a Ukraine born pianist and piano educator, a wife of Josef Lhévinne, who was a celebrity Russian pianist.

⁶⁴ John Browning (1933-2003) was an American pianist, a pupil of Rosina Lhévinne.

⁶⁵ Spanswick, Melanie. (2018, Mar 18). Re: Honest Insights and Some Forgotten Exercises [The Classical Piano and Music Education Blog]. Retrieved from

<https://melaniespanswick.com/2018/03/18/honest-insights-and-some-forgotten-exercises/>

(Accessed on Mar 20, 2021)

pianist through learning Plaidy's methods. This demonstrates its efficiency for late beginners. Thus, I tried to find appropriate methods for late beginners in Plaidy's book.

For the first time in piano education history, Plaidy (1875) separates professional and amateur students to analyse their learning motivation and purpose. He believes that amateur students should acquire artistic accomplishment and learn specific skills of composition. Plaidy also thinks that music theory is necessary even for amateur students.

Regarding posture, Plaidy has a unique approach in his book that involves describing the centre of gravity of the palm (Plaidy, 1852). Plaidy wrote, "*The centre of gravity of the hand in playing should fall inwards, i. e. to towards the thumb.*"⁶⁶ It requires the hand to be placed horizontally and to hold up the fifth finger firmly so that the centre of gravity of the hand can be inclined to the thumb.

On the time allocation for piano practice, Plaidy points out that professional students need at least four hours per day, while amateur students need at least one hour per day, and they should be allocated at different times of the day. In most daily practice, beginners need to practice finger exercises very carefully until they can firmly support their hands and fingers. At the same time, Plaidy

⁶⁶ Plaidy, Louis. (1875) *Technical Studies for the Piano*. New York: G. Schirmer. p. 3.

strongly opposes using equipment to help finger practice; he thinks the equipment could ruin hands and fingers and cause stiffness. (Plaidy, 1852) According to Plaidy's suggestions, He enabled students to practise many finger exercises to achieve the effect, which still lacks efficiency. On the other hand, Plaidy seems only to see the downside of misusing equipment but failed to consider the benefits if used correctly and reasonably.

Plaidy points out the problems of beginners who have bad habits in performance or play the piano lack of playing manners. Thus, he advised that

*...first of all study the first section (that is, the slow trill) with great care, and not go on to the following sections until they can execute the first in a strictly correct manner. Then let them familiarize themselves with the scales that occur most frequently, and with some of the broken chords, and afterwards take up the other sections one by one.*⁶⁷

In addition, for the problem of unbalanced finger keystrokes, especially when the thumb is knocking or the other fingers tend to be stiff, Plaidy gives the following solution:

*...They should, therefore, moderate the force of the thumb, and endeavor to make that of the fourth and fifth fingers equal to the others. We would recommend their practicing passages which are to be executed by these two fingers, with a stronger touch.*⁶⁸

⁶⁷ *Ibid.*, p. 6.

⁶⁸ *Ibid.*

Consequently, instructors should pay attention to whether students correctly play with the thumb by using its CMC joint rather than the MCP joint, especially for beginners. Meanwhile, the MCP joints should hold more firmly to horizontalize the palm because the fourth and fifth fingers are relatively weak. Plaidy's method strengthens the keystroke of the fourth and fifth fingers, and the keystroke strength of five fingers can become more balanced.

After pointing out all students' problems and putting forward solutions and suggestions for practising, Plaidy provides many small exercises (Plaidy, 1852). Among them, scales and rapid-passage practice will be discussed in Chapter V. These methods can help solve the playing problems found in the questionnaire surveys of Chapter III among late beginners.

At the end of the book, Plaidy gives some suggestions for score reading, and it is the first time I found the score reading discussion among the books I researched. He suggests: 1) Students should learn rudiments (music theory) well, and the knowledge of harmony is also necessary; 2) The most important thing is that practicing a piece from beginning to the end without stopping, and choosing an appropriate tempo for practice; 3) Playing more four-hands works and playing with other instruments is helpful as well (Plaidy, 1875). Score reading requires flexible fingers, a sense of rhythm, and specific music theory knowledge. Moreover, it also requires the efficient cooperation of our locomotive organs, which will be mentioned in the 20th and 21st-century approaches. In addition,

according to the level of difficulty, Plaiddy (1875) provides lists of practice repertoire and gives some suggestions for practising difficult works. (pp. 85-86) They will be used as a reference for the exercises for adolescent beginners in Chapter V.

Next, I want to talk about two of the most excellent methods at the end of the 19th century, written by Leschetizky⁶⁹ and Deppe⁷⁰. Leschetizky was a disciple of Czerny and trained many celebrated pianists, including Vasily Safonov⁷¹, Ignacy Jan Paderewski⁷², Franz Schmidt⁷³ and Isabelle Vengerova⁷⁴. Unfortunately, Leschetizky did not write any method books, but his student and teaching assistant, Malwine Brée, wrote a method book, *The Groundwork of the Leschetizky Method*. Brée thinks that Leschetizsky's method is not exactly for beginners or children, but for those students who have obtained some rudimentary training (Brée, 1902). However, in my opinion, the contents

⁶⁹ Theodor Leschetizky (1830-1915) was a Polish pianist composer and piano educator.

⁷⁰ Ludwig Deppe (1828-1890) was a German composer, conductor, and piano educator.

⁷¹ Vasily Safonov (1852-1918) was a Russian pianist, piano teacher, and composer. His notable pupils include Alexander Scriabin, Josef Lhévinne, etc.

⁷² Ignacy Jan Paderewski (1860-1941) was a Polish pianist and composer, also the prime minister of Poland.

⁷³ Franz Schmidt (1874-1939) was an Austrian composer and pianist.

⁷⁴ Isabelle Vengerova (1877-1956) was a Russian pianist and music educator. Her pupils include Samuel Barber, Leonard Bernstein, Gray Graffman, etc.

concerning performance posture and primary practice methods (scales and arpeggios) in this book can be used for late beginners.

In Leschetizsky's method, he explicitly states the merits and demerits of big and small hands and the coordination of arms and wrists.

*Too large hands are not always advantageous at the piano; but too small hands are often a disadvantage... Large hands, again, show superiority in widespread chords, which small hands have to make good by means of dexterity and suitable arrangements... The method of holding them is same for both.*⁷⁵

Also, regarding the movements of the wrist and arm, and coordination, he thinks that

*...the wrist, which serve to facilitate the execution of phrases, to support the rhythm, or to rest the hand after the tension of forte-playing by relaxation of the joint...The arm, to be sure, remains a clumsy fellow, always having to be guided lest he throw fingers and wrist off the track by faulty movements.*⁷⁶

In the methods of the 19th century, this is the first time for a method to mention physiological differences. Leschetizsky tells us that in piano playing, the hand, wrist and arm should play cooperatively, and according to the music, the fingers should guide the movement of the wrist and arm. Those who advocate keeping

⁷⁵ Brée, Malwine. (1902) *The Groundwork of the Leschetizky Method*. New York: G. Schirmer. p. 2.

⁷⁶ *Ibid.*, p. 78, 80.

the wrist without much movement are too conservative, which is against the basic principle of human kinematics.

Leschetizky was aware of the role of physiology and realised the importance of psychology in piano playing. In practising chords, he suggests that the hand prepare the chord according to the shape you get from the score, and he called this “physiognomy recognition” (Brée, 1902). Players should not just strike the keys with fingers, but use eyes to visualize the music score, then transmit the information to the brain, and to fingers. At last, you can even turn the score into a language or hum it in a low voice. Meanwhile, the player should also use ears to predict and detect whether the sounds produced are correct or satisfactory. Visualizing music scores can improve the speed of score reading and achieve higher efficiency in practice.

More than that, Leschetizky also thinks that self-criticism is an essential factor in piano playing.

Whoever has got so far as to criticize himself as sharply as his neighbor, is far advanced; for even the recognition of one's faults means much, although there is yet a long step to their amendment.⁷⁷

⁷⁷ *Ibid.* p. 77.

Self-evaluation is significant in the psychological development of teenagers, which has been discussed in Chapter II. Therefore, it can be said that Leschetizky's perception was quite comprehensive and scientific for his time.

One of the main trends in the 19th century was that almost every method advocated learning music theory at first. Although Leschetizky did not directly mention music theory learning, most of the techniques in the book are directly related to music theory statements. Therefore, Leschetizky also emphasised the music theory knowledge is important for beginners.

Additionally, concentration is highly valued in his method. Annette Hullah even asserted that concentrated thought is a cornerstone of Leschetizky's method, and if you stop thinking about music, you can do nothing (Hullah, 1906). It is also my personal experience. I found it challenging to play some difficult parts of pieces, not because of the hands' lack of playing skills, but because I did not concentrate on or fully understand the music (in terms of rhythm, beats, or musical character).

Leschetizky also gives six suggestions on practising and learning piano for beginners, which will be discussed in Chapter V. In summary, these six suggestions are: 1) When you start to learn the piano, you can practise with small sounds, and it is no need to make it loud; 2) Do single-hand practice and rest at any time to avoid muscle fatigue; 3) While playing you can move your hands

slightly up and down to prevent stiffness; 4) When lifting fingers, keep them bent to prevent the loss of tension and strength of fingers; 5) Touch keys with the fingertips; 6) When playing *forte* or striking the black keys, you need to outstretch fingers instead of bending them (Brée, 1902).

Regarding Deppe, I first have to mention another person, Caland. She was a pupil of Deppe, and she published several books about the pedagogy and practice methods of Deppe. These books recorded Deppe's methods and made an immense contribution to the development of piano methods in the 20th century. In one of these books, *Artistic Piano-Playing as Taught by Ludwig Deppe Together with Practical Advice on Questions of Technic*, Caland complemented his methods and made contents more detailed and intuitive. Thereupon, the Deppe-Caland method was formed.

Deppe's methods can be summarized into two aspects. Firstly, Deppe opposes the Lebert-Stark school because he believes it can cause fingers and other locomotive organs to get fatigued quickly. Thus, Deppe suggests a low seat, and he thinks this position could release fingers and relax arm and shoulder muscles (Caland, 1903). Caland has given a supplementary explanation for the position.

Figure 4.6

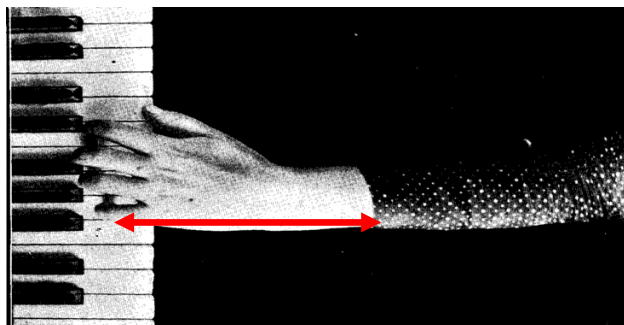
Deppe's posture (a)



Source: Caland, Elizabeth. (1903) *Artistic Piano-Playing as Taught by Ludwig Deppe Together with Practical Advice on Questions of Technic*. New York: G. Schirmer. P. 27

Figure 4.7

Deppe's posture (b)



Source: Caland, Elizabeth. (1903) *Artistic Piano-Playing as Taught by Ludwig Deppe Together with Practical Advice on Questions of Technic*. New York: G. Schirmer. P. 28

...when the hand is laid on the keyboard, the level of the elbow is seen to be trifle lower than that of the white keys (see Figure 4.6) ...the line formed by the fifth finger, the outside of the hand, and the forearm should be a straight one (see Figure 4.7).⁷⁸

⁷⁸ Caland, Elizabeth. (1903) *Artistic Piano-Playing as Taught by Ludwig Deppe Together with Practical Advice on Questions of Technic*. New York: G. Schirmer. pp. 26-28.

The middle finger is important (see *Figure 4.7*) as the central axis of the whole hand activity, and it is related to the movement of the arm and shoulder. Deppe believed that the fingers could completely obtain independence, and each finger could obtain the same strength (Caland, 1903). However, this lacks scientific grounding. Nevertheless, our skeletons are like the frame when building a house, which can firmly support the whole hand and diffuse the loads from external force.

Secondly, according to Caland (1903), Deppe asserts that the hand should be as light as a feather. He explains the interrelation of the wrist, hand, and arm: the hand-weight is supported by the wrist, which is in turn supported by the forearm, in turn supported by the upper arm. As Caland added, this *lightness is an impossibility unless the shoulder, not hand, sustains and carries the arm's weight.*⁷⁹ In Deppe's method, we can see that piano playing requires the participation of the whole arm, even the shoulder. It also proved that Deppe realised the importance and necessity of coordinating muscles; it is "muscular synergy" in Deppe's words.

About the muscular synergy, Caland noticed that,

Force is not transmitted to the muscles, but is engendered by them... if we wish to put into any movement every available atom of energy, then we must obtain the concurrent working of the greatest possible number of muscular

⁷⁹ *Ibid.*, p. 22.

*fibers... it is indispensable that they be fashioned under the law of a common rhythm, and this is what we understand by muscular synergy.*⁸⁰

For late beginners, explaining the physiological principle above is important. After they understand the source of energy and force, they will not force themselves to play unnecessarily strong tones. Instead, they will use their fingers to avoid hand stiffness and limb pain. Muscular synergy is the root of Deppe's method, and simultaneously, it is the basis of weight touch, which was sufficiently used in the 20th century. Weight touch is one of the most effective methods in modern times; therefore, I will discuss this method in the next part, including its function, exercise, and development. Also, I will analyse its scientific basis in physical mechanics.

Deppe's method is the basis of many subsequent scientific piano methods. After Deppe's death, more and more methods focus on the physiological, psychological, and kinematic fields. Thus, it can be said that Deppe is a turning point from empiricism to practical scientism in piano method research. So far, all the representative piano methods of the 19th century have been introduced. To capsize, I made a summary with charts as follows. Then, I checked the contents of these method books and made *Tables 4.3* and *4.4*⁸¹ to show what each book contains.

⁸⁰ *Ibid.*, p. 24.

⁸¹ Italy (IT), Austria (AT), United States (US), Poland (PL).

Table 4.3

The summary of the 19th century's methods (a)

	(IT) M. Clementi	(FR) L. Adam	(DE) D. Graupner	(DE) D. Steibelt	(AT) J. N. Hummel	(AT) C. Czerny	(DE) F. W. Kalkbrenner
Body position		○		○	○	○	
Hand position and movement	○	○	○	○	○		○
Wrist-use		○		○		○	○
Finger position and movement	○	○	○	○	○	○	○
Arm position and movement		○		○		○	○
Touch		○		○	○	○	○
Scale	○	○	○	○	○	○	○
Arpeggio	○	○	○		○	○	
Intervals (double-notes, octave)	○	○	○	○		○	○
Chords	○	○	○			○	○
Rhythm	○	○	○	○	○	○	○
Phrasing				○	○		○
Ornaments	○	○	○	○	○	○	○
Fingering	○	○	○	○	○	○	○
Shake (Tremolo)	○	○			○	○	
Pedal		○		○	○	○	
Musical terms	○	○	○	○	○	○	
Note, Mark, Solmization	○		○	○	○	○	○
Muscular, relaxation					○		
Weight-use							
Sight reading						○	
Skeleton							
Memorising						○	

*Made by the author

Table 4.4

The summary of the 19th century's methods (b)

	(FR) J. T. Latour	(DE) F. Hüntten	(AT) H. Herz	(FR) H. J. Bertini	(UK) C. C. Spencer	(US) N. Richardson	(DE) L. Plaidy	(PL) T. Leschetizky
Body position	○	○	○	○			○	
Hand position and movement		○	○	○		○	○	○
Wrist-use	○	○		○		○	○	○
Finger position and movement	○	○	○	○	○	○	○	○
Arm position and movement	○		○	○		○	○	○
Touch			○		○		○	○
Scale	○	○	○	○	○	○	○	○
Arpeggio			○	○	○		○	○
Intervals (double-notes, octave)		○	○	○	○	○	○	○
Chords		○	○	○	○	○	○	○
Rhythm	○	○	○	○	○	○	○	○
Phrasing			○					○
Ornaments		○	○	○	○	○	○	○
Fingering	○	○	○	○	○	○	○	○
Shake (Tremolo)							○	○
Pedal			○				○	○
Musical Terms	○	○	○	○	○	○		
Note, Mark, Solmization	○	○	○	○	○	○		
Muscular, relaxation		○				○		○
Weight-use								
Sight reading							○	○
Skeleton						○		
Memorising								

*Made by the author

From *Table 4.3* and *Table 4.4*, we can find that musical composition and the development of piano instrument structure interrelate with each other. In history, we know that composers' creative needs sometimes guided manufacturers to improve piano structure. Therefore, the piano becomes more and more capable of creating expressive sounds, it leads to the birth of more and more performance techniques and music expression. As a result of that, the contents of pedagogies and methods get more and more comprehensive and practical. Moreover, the tables show the following results: unlike the pedagogy of the 18th century that only concentrated on finger-use, 19th century pedagogy was more holistically concerned with all locomotive organs, from fingers to shoulders.

Secondly, in the 19th century, with the innovation of piano structure, composers and pianists wanted to fully express the musicality of the piano; thus, more and more techniques were born. Therefore, the variety of techniques introduced by method books increased, and their learning methods and practice suggestions became more comprehensible and reasonable. Moreover, in the early 19th century, due to piano players' eagerness to master techniques rapidly, the exercising devices were vigorously promoted to help fingers improve through supplementary physical exercise. However, the use of these devices use was considered unacceptable in the late 19th century because many pianists damaged their fingers after practising with them. As far as I am concerned, using these devices needs to be done in accordance with modern scientific physiology, body kinematics, and physics, to find a reasonable practice method.

Thirdly, the importance of music theory was widely recognised in this period. These representative method books all included music theory, and some books even analysed techniques combined with music theory. All of these method books agreed that music theory study would accelerate the pace of piano learning. In my opinion, this can be effective mainly for late beginners who have developed a certain cognitive and independent thinking ability. Music theory plays an essential role in the score reading and memorisation that are entailed in these methods. Most people would say music is a language; indeed, music theory is grammar, and musical notes are the vocabulary of piano music. Therefore, when you are learning a new language, grammar and vocabulary are usually learned simultaneously.

Finally, piano methods in the 19th century evolved to become more comprehensive, precise, and reasonable than before, and the research direction gradually turned to the scientific side at the end of the century. Due to the advancement of the Industrial Revolution, science and technology became more developed, and at the same time, the piano structure was also improved further. Therefore, some books in this period mentioned the necessity of learning piano structure. Although the methods in the 19th century are traditional from our perspective, I found there are still lots of possibilities worth exploring, especially for late beginners and piano learners who have special goals.

4.3 Introduction to Piano Methods in the 20th Century

Entering the 20th century, the development of piano methods and pedagogies strode forward to a new stage and eventually metamorphosed from “empiricism” into “experimentalism”. At the beginning of the 20th century, the piano methods followed the same developmental pattern as the late 19th century but finally established the weight-touch school. Afterwards, with the development of science, research on anatomy and physiology proliferated, which caused more and more researchers to begin explaining music and piano methods through science. Therefore, many piano method hypotheses of the 19th century have been gradually verified. Thus, the piano method has turned to be materialised and visualised.

For the 20th century, I also selected several representative methods. They are the methods of Isidor Philipp, Rudolf Maria Breithaupt, Otto Ortmann, Tobias Matthay, William Stein Newman, Abby Whiteside, József Gát, and György Sándor. Their methods evolved from traditional ideas as more rational and scientific means have been used to interpret efficient performance methods.

Isidor Philipp⁸² studied the piano with Georges Mathias⁸³, Camille Saint-Saëns, and other musicians. Philipp’s method, *Complete School of Technic for*

⁸² Isidor Philipp (1863-1958) was a French pianist, composer, and an educator.

⁸³ Georges Mathias (1826-1910) was a French pianist, composer, and educator. A pupil of Kalkbrenner and Chopin.

the Pianoforte, inherited the essence of Deppe. The relationships between fingers, wrists, and arms have breakthrough developments in his method. Thus, I found some suggestions that can help adolescent beginners from his method.

Philipp (1908) gives some advice for practice to students with small hands. He mentions that small-handed students could practice double sixths as preparation for the octave. That is because *the fifth fingers' knuckles are easily kept firmly rounded up and strengthened for the heavier task required of them in octaves.*⁸⁴ Also, Philipp gives a position for smaller hands to use when playing chords: *An elevated wrist, with knuckles and joints rounded out as much as possible.*⁸⁵

The questionnaire survey in Chapter III found that many students are unable to play octaves because their hands are naturally small or cannot be stretched because they are insufficiently limber. Philipp's method attempts to help late beginners play octaves and chords well. Indeed, there is a need for more scientific research to help hand stretching.

When Philipp (1908) talks about each playing method, he integrates the use of fingers, wrists, and arms, mostly emphasising wrists. Concerning the hand position for scales, Philipp said *the hands point in, and the wrists are rounded*

⁸⁴ Philipp, Isidore. (1908) *Complete School of Technic for the Pianoforte*. Philadelphia: Theodore Presser. p. 86.

⁸⁵ *Ibid.*, p. 98.

*out and about level. The knuckles are raised, and the fingers full-curved. The thumb tips are bent inward.*⁸⁶ He also wrote exercises similar to Liszt's for finger extension and independence: keeping three notes (chords) held and practising with the other two fingers. Moreover, Philipp notes how to practise them,

*...the exercises for some time should be practised piano... The less the effort made to hold the chords down and to move the fingers, the more freely the muscles will stretch. The fingers are curved as much as possible, the knuckles raised, the wrists at times elevated, at others held low. Transpose.*⁸⁷

We can see that Philipp regarded wrist usage to be of great importance, which is consistent with Couperin's view. His method is also similar to the method of Leschetizky, which involves using hands upward and downward motions according to music. These motions can reduce muscle tension, not only in hand muscles but also in arm muscles. In addition, Philipp considers that broken chords can help to strengthen the fifth finger (Philipp, 1908).

Besides Phillip's interpretation of wrist function, using the arm using is also be mentioned in his method. Phillip talked about how to use the arm to play octaves, particularly octave jumps. He thought that the arm should assisted by the wrist, elbow, and fingers. (Philipp, 1908) The octave tremolo *is executed by combining the finger movement with a vibrating side-twist from the forearm*⁸⁸.

⁸⁶ *Ibid.*, p. 22.

⁸⁷ *Ibid.*, p. 47.

⁸⁸ *Ibid.*, p. 104.

The tremolo should only be *played with a close vibrating movement from the wrist*⁸⁹, and the chord tremolo is played with the entire arm. His explanation of the arm usage is the most detailed so far. Each technique is played by using reasonable hand and fingers movement, which makes technique practice more efficient.

Lastly, I would like to recommend Phillip's methods to adolescent beginners. On the one hand, Philipp opposed the high finger school (Philipp, 1908). We cannot say that the high finger technique is wrong, but fingers should move in terms of music as I discussed above. Therefore, it is unnecessary to emphasise high fingers at the initial stage because overusing the high finger technique is contrary to the principle of human anatomy and impedes the coordination of hand – wrist – arm – shoulder. On the other hand, he believes that beginners should first stabilise the hand position and not produce loud sounds unless they are already familiar with the hand position (Philipp, 1908). In other words, it means do not rush to play with *forte* but to use the hands reasonably and naturally at the beginning and strengthen the muscles afterwards. In conclusion, Philipp's methods relate to Deppe and Leschetizky in the aspect of the movement of hands and arms, and they promoted the establishment of the landmark method – weight touch.

⁸⁹ *Ibid.*

It can be said that the weight touch is one of the greatest developments within piano technique of the 20th century. This method germinated in Deppe's time, and we can even see earlier approximations in Leschetizky's time. However, in 1909, Rudolf Maria Breithaupt⁹⁰ published *School of Weight-Touch*, which is the second volume of his book series *Natural Piano-Technic*, and this book formally established the weight-touch school in history. This method is based on physiology and analysed the internal functions of piano playing more thoroughly. Moreover, it also perfected the function of muscular synergy in piano playing. As far as I am concerned, weight touch can be used to help adolescent beginners practise techniques naturally and scientifically.

Based on Steinhausen's theory⁹¹, Breithaupt believes that psychological and physiological principles are required when interpreting music (Breithaupt, 1909). Therefore, Breithaupt wants to find a natural playing method to emancipate piano students from stiff limbs and motions, finally achieving dexterous and flexible locomotive organs. Weight-touch needs a mature skeleton structure and muscle system because it needs a firm hand bridge for support and a mature nervous

⁹⁰ Rudolf Maria Breithaupt (1873-1945) was a German piano educator and composer.

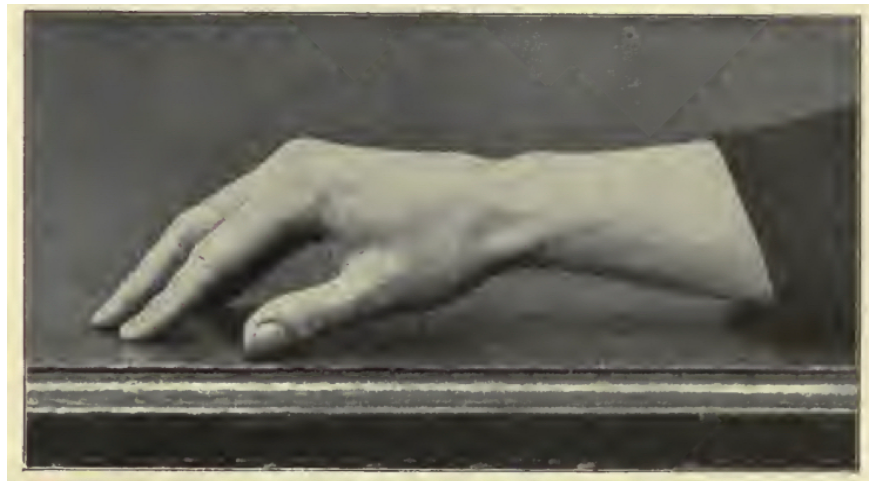
⁹¹ Friedrich Adolf Steinhausen (1859-1910) was a German doctor. He contributed a physiological basis for weight touch, which replaced the traditional techniques based around five-finger-exercises. His research was influenced by Deppe, and his physiological theories in piano playing built a bridge between Deppe and Breithaupt.

system for perception and control. Therefore, the weight-touch method is an emergency rescue for adolescent beginners.

At the beginning of the *School of Weight-Touch*, Breithaupt shows several pictures of hand position. First, put the hand and forearm flat and relaxed on the table, then set up the hand as shown in *Figure 4.8* shown below, supporting the knuckle joints to make a hand bridge (Breithaupt, 1909).

Figure 4.8

Breithaupt's hand position



Source: Breithaupt, Rudolf Maria. (1909) *Natural Piano Technique Vol. 2: School of Weight-Touch-Natural Piano Technic*. Leipzig: C. F. Kahnt Nachfolge. p. 7

We can see from the picture that the wrist does not sit on the table but is suspended. Whereas Prof. Hughes also taught a similar position to produce better sound, the only thing different with Breithaupt is that Prof. Hughes required the wrist to sit on the table, then for the student to lift fingers in turn, dropping them

down as their weight is felt. Actually, a low set wrist can increase the flexibility of fingers, and a better sense of motion of the third knuckle joint can be obtained.

After determining the hand position, another requirement of weight touch is arm usage, and Breithaupt said,

*...when combined with the elastic muscular tension of the whole physical apparatus set in motion (shoulder, upper- and fore-arm, hand, fingers), constitutes the fundamental elements of piano-technic...The arm, hanging loose and inactive in the shoulder-joint, is "supported" by the hand or by the fingers.*⁹²

This again proves the coordination function between the four members: fingers, wrists, arms, and shoulders. Furthermore, muscular synergy is emphasised once again.

Breithaupt (1909) analysed weight in two aspects, weight testing and release. The weight testing can help relax the arm, and his way is similar to a method popular in Chinese piano education. First, the teacher helps students raise their arms to a certain height; at this time, students' arms should be completely relaxed. Then tell students are told that when withdrawing hands, the arms should fall freely with gravity. Additionally, their fingers need to stand firmly on the keys straight and keep other playing members (wrists, arms, shoulder and back) relaxed, without stiffness. (pp. 13-18) However, Breithaupt explained the most

⁹² *Ibid.*, pp. 11-12.

important method, weight-transfer, which can prevent stiffness and fatigue during the five-finger exercises. Moreover, releasing the weight will help play chords and dynamic pieces. (Breithaupt, 1909)

Breithaupt summarised four actions in the book. For the first action, *The longitudinal oscillation of the arm*, Breithaupt (1909) proposed two playing motions, low-fall and high-fall, which will be discussed in Chapter V. This motion requires flexible wrists because it connects the hand and arm and plays an important role in weight-transfer. (pp. 19-24) The second action is called *Extension of fore-arm*. At first, Breithaupt (1909) emphasised *the four most important actions: Swinging – extension of fore-arm – rolling of fore-arm – free oscillation of the fingers*.⁹³ Using these actions allows the limb to gain more freedom and flexibility, and to avoid rigidity. Moreover, they are suitable for playing rapid passages, especially octaves and chords. (pp. 25-30) The third action is called *Rolling of fore-arm*. The Deppe-Caland method mentioned the concept of hand pivot, and Breithaupt added here:

the outward twisting of the fore-arm together with the hand, showing the palm turned upwards, is called “supination” ... the hand turned inwards, being “pronation”.⁹⁴

⁹³ *Ibid.*, p. 25.

⁹⁴ *Ibid.*, p. 32.

We can refer to *Figure 4.6*. In Deppe-Caland's hand position, the fifth finger and ulna are in a straight line; In Breithaupt's method, the fifth finger acts as a fulcrum, and the ulna as the pivot to complete the rolling technique. Among piano techniques, rotation is the most beneficial technique; in particular, it is the essential skill for scales and arpeggios. Rotation will be introduced in Chapter V because it is a necessary skill for adolescent beginners, which will enormously improve their practice efficiency.

Going back to Breithaupt's book, after the rotation technique, Breithaupt (1909) introduces scale practice based on the rotation skill. He also recommends practising B major scale in the beginning, in concurrence with Chopin's viewpoint. Furthermore, he suggests a scale practice order for the rotation: *F# or Gb, B and Db. Then follow Ab and Eb, E and A major. Finally, the remaining major and all the minor scales*⁹⁵. The fourth action is the *Free oscillation of the fingers*. After discussing the arm, forearm, and wrist, Breithaupt starts to talk about fingers. As he believes that

*It is wrong to start training the fingers from a strictly curved position... as first of all, arm and hand must be taught to remain supple and loose and learn how to assume and transfer the weight.*⁹⁶

⁹⁵ *Ibid.*, pp. 37-38.

⁹⁶ *Ibid.*, p. 55.

Indeed, for late beginners, as a result of their physiological conditions, training should begin with the exercise of upper limbs (arms and shoulders); Saving exercises with fingers for last can improve their flexibility quickly. It is possible to shorten the time of the primary learning stage, thereby achieving efficient practice. In addition, weight-transfer can be used for various touches, such as legato, staccato, and other techniques.

In the last part of the method, Breithaupt (1909) expounds the performance techniques often encountered in playing practice methods. The performance techniques include polyphony, two hands playing with different motions, dynamics, aesthetics, touch, rhythm, and fingering. Concerning the various motions of the two hands, it is a problem we have observed with late beginners in Chapter III. Breithaupt mentioned three impeding movements and realised they are interfered with by nerve centres. (pp. 57-58) In addition, Breithaupt also mentioned the influence of individual differences such as small hands and finger thickness on practice (Breithaupt, 1909). His strategies and methods can be used for adolescent beginners, and I will discuss them in Chapter V.

At the end of the book, there are some advises for daily practice. Breithaupt (1909) explains the source and types of resistance in playing from the perspective of physics, which is “force and reaction”⁹⁷; simultaneously, he emphasised the importance of learning music theory and explains the difference between

⁹⁷ Referring to Newton’s third law of motion.

stiffness and clumsiness. Furthermore, Breithaupt also explains the reason for the stiffness and clumsiness. He thinks that clumsiness is more influenced by psychological side, while stiffness comes from the physiological side. On the other hand, one way to overcome clumsiness is through concentration (p. 92). At last, Breithaupt gives several suggestions for beginners. Breithaupt holds that learning solfeggio is fundamental because it is a kind of psychological technique. This technique will help to read scores faster and to correct rhythm. Moreover, the respiratory system also influences performance. (pp. 92-98)

In general, Breithaupt's research is based on physiology, which leads to an examination of often-overlooked physical properties of fingers, wrists, arms, and shoulders in piano playing. His weight-touch method is the core of this research. Breithaupt realised the influence of the nervous system on piano playing. However, he confused the psychical and psychological fields. Nevertheless, Breithaupt's research still laid a physical and physiological foundation for further research. Afterwards, more and more researchers began to focus on studying the central nervous system, and the most representative person is Ortmann.

Otto Ortmann⁹⁸ devoted himself to finding a correct, natural, and scientific manner in which to perform piano art. His predecessors, especially the Deppe-Caland and Breithaupt methods, analysed the principles of various movements and techniques in piano performance by integrating anatomy, physiology, and

⁹⁸ Otto Rudolph Ortmann (1889-1979) was an American pianist, educator and researcher.

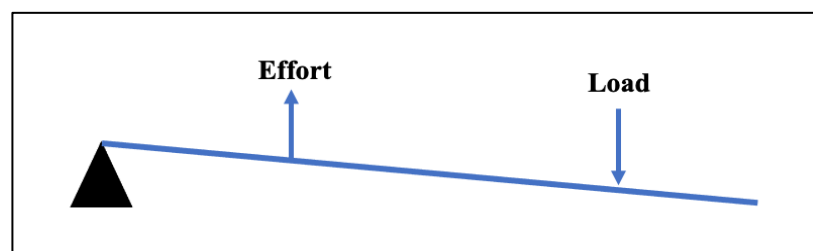
kinematics. Furthermore, Ortmann even tried to explain the correlations between the nervous system and piano playing.

Concerning Ortmann's research, he published *The Physiological Mechanics of Piano Technique* in 1929, and I have picked out the methods that can be used to guide adolescent beginners, which are almost all linked to human beings' physiological function. In this chapter, I will briefly talk about Breithaupt's book, and in Chapter V, I will discuss his practise methods and pedagogy in detail. Ortmann's book is divide into three parts.

In Part I, Ortmann (1909) introduces three kinds of lever principles and explains the composition of forces. Then he deduces that there are many levers in the human skeletons, and he concludes that most muscles serve to activate levers in piano playing. (pp. 12-19) Ortmann noted that these levers are third-class levers, in which the effort is between the fulcrum and resistance (Ortmann, 1929). See *Figure 4.9*

Figure 4.9

The third-class lever



*Made by the author

The third-class lever is the hardest lever, effort between the fulcrum and resistance. Common objects such as tweezers and staplers both belong to this class. Though it needs much effort, its displacement is shorter than other levers. Due to this advantage, third-class levers are spread all over human anatomy, notably in our arms. The application of its mechanics will be described in Chapter V.

Next, Ortmann (1929) elaborate on the functions and anatomical properties of the skeleton and muscles. In the chapter on the skeleton, Ortmann first emphasises the importance of the radio-ulnar joint. He thinks the radio-ulnar joint is key for the forearm rotation, but not the wrist joint, because *the axis of forearm rotation extends through the head of the ulna in a line with the fourth finger of the extended hand, not the third finger.*⁹⁹ While nowadays some instructors still believe that the axis is the third finger, this viewpoint seems to be influenced by the old school. Then, the vertical and horizontal movements are discussed in the following section of the book. Each movement is explained in relation to the shoulder, elbow, wrist, and finger joints to reveal their anatomical properties. At last, each joint's application in piano techniques is discussed. (pp. 19-39) This section will be mentioned in Chapter V because it is a scientific way of playing and will significantly improve practice efficiency of adolescent beginners.

⁹⁹ Ortmann, Otto. (1929) *The Physiological Mechanics of Piano Technique*. London: Kegan Paul, Trench, Trübner & Co. p. 16.

In the chapters on muscle, Ortmann (1929) provides eight foundational techniques to explain muscular state, properties, and coordination. It is worth noticing that Ortmann explicates the mechanism of rigidity. Physiologically, there are two conditions that produce rigidity: when the production rate of lactic acid is higher than its decomposition rate, and when the antagonistic muscles are contracted simultaneously. (pp. 57-59)

When rigidity reaches an unnecessary degree, or when it is unnecessarily present in some joint not acting as a transmission-point for the force, does it constitutes what the piano teachers calls “stiffness” ... if the rigidity is present in a joint where movement would facilitate the total action, the condition seriously interferes with the ease, accuracy, and speed of the movement.¹⁰⁰

Consequently, it is indispensable to rest appropriately in piano practice, and the rest motions which is hidden under the sleeve during playing to avoid fatigue and stiffness. On the other hand, muscular synergy is requisite, and can help pianists prevent hand injury.

At the end of Part I, Ortmann introduces the principles of the nervous system. He advocates that student need to do some finger exercises before playing the piano, which can promote blood circulation. More importantly, Ortmann realises that the motor area of the brain and adequate blood supply are supporting a

¹⁰⁰ *Ibid.*, p. 58.

function vital to the nerves and muscles in piano playing. This is the basis of contemporary scientific piano performance research. (Ortmann, 1929)

Part II is about weight touch. We can find that Ortmann's weight-touch is an updated version of Breithaupt. Ortmann integrates Newton's third law of motion, the inertia law, and the muscular contraction principle in discussing the mechanism of weight transfer (Ortmann, 1929). This transmission mechanism will significantly enhance the performance efficiency of scales, arpeggios, and other skills, and achieve economical movements.

In Part III, the last part, Ortmann integrates the theories of physics, physiology, and kinematics with the piano playing methods that the preceding two parts have discussed, including reasonable body actions and how to achieve economical playing (Ortmann, 1929). However, because of Ortmann's viewpoint on physiology and physics, his methods are not proper for young children, but the matured piano player. Therefore, in Chapter V and my future research, I will refer to Ortmann's methods for working out an efficient and scientific piano method for adolescent beginners.

If Ortmann's weight touch is an updated version of Breithaupt's method, Tobias Matthay's piano methods can be said to be an updated 2.0 version of weight-touch. Matthay¹⁰¹ wrote two celebrated and representative piano method

¹⁰¹ Tobias Augustus Matthay (1858-1945) was a British pianist, composer and educator.

books, *The Act of Touch in All Its Diversity*, published in 1903 and *The Visible and Invisible in Pianoforte Technique*, published in 1932. The second book was published in almost the same period as Ortmann's method. Both discuss piano playing based on the physiological principles of muscular function. However, their focus is different.

The Act of Touch in All Its Diversity mainly discusses the key touch and keystroke using physiological principles, including muscle shape, physical execution, and other body functions. It then mentions lever manipulation of weight and muscles, which is like Ortmann, revealing that Matthay also believes that the lever's function in piano playing is essential. As the first experimental work of Matthay, *The Act of Touch* lays the foundation for the "invisible" contents of the next book, *The Visible and Invisible in Pianoforte Technique*.

Concerning the title of the book, visible and invisible insinuates that there are actions and reactions we can observe by our eyes directly, as well as things we cannot observe directly; there are actions and reactions hidden under the sleeve of pianist. As Matthay (1932) mentions in the book, limb stress is a kind of visible and invisible muscular problem, and it is a critical point that teachers should help students understand (p. ix).

At the beginning of Matthay's book, he emphasises that techniques do not originate from the mechanical practice of hands but from the music itself.

(Matthay, *The Visible and Invisible in Pianoforte Technique*, 1932) Therefore, students should focus not only on the technical practice of hands but also on understanding music. Establishing a bridge between musicality and techniques with hands is the essential substance of Matthay's research on piano performance. Undoubtedly, if you want to understand music, students should receive a thorough grounding in music theory. Furthermore, Matthay (1932) refuted anatomical research in piano playing; however, he asserts that direct sensation is a valuable and vital key (p. 15). Thus, he underscores the importance of psychology and physical awareness during piano playing. However, although Matthay realised this critical point, this book still lacks a discussion of the role of the nervous system. Nevertheless, his conclusion brings enlightenment to research in the 21st century.

Another important point in Matthay's book is his insight concerning the two types of finger positions, bent and flat. Matthay considered neither position to be right or wrong; they should be used according to the type of notes and the size of the player's hand (Matthay, 1932). I believe that most students and even teachers nowadays have been confused by this problem. These two positions are related to the function and cooperation of big and small hand muscles. Therefore, distinguishing and using these two kinds of muscles is necessary. Moreover, we need to remember that the direction of finger movement on the keys should always be vertical, which is the same as Ortmann's method.

Matthay (1932) divided arm movements into six functions: 1) The balanced arm, which includes arm vibration, weight transfer, and hand exertions; 2) Forearm rotation, which is considered an essential technique for piano playing. Matthay believes it can solve all finger-work problems. Arm rotation has always been emphasised in past piano methods, but it was only from Deppe-Caland that we realized the true role of this technique more rationally through scientific methods. Unless late beginners obtain the rotation technique, they are not able to practice effectively. However, rotation cannot be used for rapid passages instead of finger movement. 3) Forearm weight; 4) Whole arm weight; 5) Forearm fall with upper arm weight; 6) Upper arm forward dig. Matthay thinks that the first two functions should be used flexibly according to different music, and the last four functions can only be used on keystrokes. (pp. 26-39)

Matthay (1932) mentions that the first thing beginners should do is relaxing arms, particularly those who were previously mistaught or have inherited muscle tension or unhealthy performance practices. He also notes that it should be practised without a keyboard. (pp. 123-124) Thus, we can see that Matthay thinks proper physical exercise is beneficial. This viewpoint is similar to Breithaupt's, which also has beginners learn to relax and use the arms at first (Breithaupt, 1909). Moreover, Matthay reiterates the principle of the lever and its application in the body and emphasises that both piano teachers and students need some knowledge of physiology and kinematics (Matthay, 1932). The scientific knowledge will help learners better understand their body function and

coordination, and it will help instructors guide different students with high efficiency.

Matthay as the founder of modern piano method research inherited the style of Deppe-Caland and Breithaupt, we need to pay more attention to the techniques that Matthay found hidden under the pianist's sleeve. He developed his piano method based on predecessors, especially Breithaupt, and brought them into the scientific stage to improve the practice efficiency of students. Furthermore, Matthay's viewpoints and thoughts have led to a surge in scientific exploration in piano methods, which can be found in the following two methods I will introduce, both from America. They summarised previous methods and pedagogies and inserted much more scientific argumentation. The first method from William S. Newman¹⁰².

Newman wrote a book, *The Pianist's Problems*, which was published in 1956. Strictly speaking, this book is not a definitive method book in the 20th century because it is more like a practical investigation report, which examines plenty of difficulties, bad habits, and weaknesses among pianists and piano students. Moreover, through utilising a series of scientific measures and combined with daily life activities, Newman discusses how to overcome those difficulties and cultivate good piano playing habits. Since this book is easy to understand and contains a large number of daily piano practice problems and solutions, it should

¹⁰² William Stein Newman (1912-2000) was an American musicologist.

be read and studied by piano players and learners. However, in my research, it is also useful as a method and reference for adolescent beginners and instructors, and they should read it and try to avoid those problems at the beginning of piano learning.

Newman (1984) thinks that four factors should be paid attention to in music learning: musicianship, technique, practice, and performance. Regarding the first factor, Newman emphasises the importance of ear-playing, which plays an essential role in sight-reading, memorisation, and helps to play music fluently. (pp. 5-18) For adolescent beginners, sight-reading is a ubiquitous problem, and ear-playing is another problem among late beginners. Hence, Newman's method can be used for those students. Additionally, memorisation is necessary when students start to learn a new piece because only by remembering the notes as fast as possible can players better focus on the music itself. Moreover, Newman's perspective on posture and position is more natural and lends more agility, which will be discussed in Chapter V.

About techniques, Newman (1984) believes that players should deal with technique according to their individual physiological conditions. He notes that factors include,

*Natural bodily grace, the nervous system's responses, the size and shape of the hand, the length and web of the fingers, "breaking" at the finger joints, and general pliability.*¹⁰³

Thus, Newman's ideas are related to the methods of Breithaupt and Ortmann. Natural motion comes from Breithaupt and the Lever principle from Ortmann. Simultaneously, Newman's method for beginners is also the same as Breithaupt's, in which students should obtain the rotation skills and learn how to relax their arms at first. Newman deeply analyses the interrelation between weight touch and gravity utilisation, which leads us to observe weight touch and weight transfer clearly. On the other hand, Newman has caught sight of the individual differences of the human body and discusses when one should use bent or flat fingers (Newman, 1984). Actually, these problems have bothered students for a long time but are now become more accessible to understand due to Newman's explanation, especially concerning weight touch (gravity utilisation).

In the second half of Newman's book, he talks about efficient piano practice methods. Newman believes that practise should be based on the three foundations: notes, fingering, and counting. Moreover, students should pay attention to the self-regulation of mental concentration where it is easy to make mistakes when playing the piano (Newman, 1984). Newman agrees with the importance of music theory and considers it is essential to cultivate the sense of rhythm. Furthermore, Newman realises the influence of the psychological side. In general, because the

¹⁰³ Newman, Stein William. (1984) *The Pianist's Problems*. New York: Da Capo Press. p. 38.

cognitive ability of adolescents is far higher than that of children, I believe such learning methods from Newman will be effective for them.

Compared with the previous methods, Newman's method is more beneficial as a reference for instructors, and its practicability can be confirmed. We can intuitively see the problems among piano players, and these practical problems have been dialectically and solved one by one, and the practicability and effectiveness of the solutions have been proved. Consequently, Newman's method will be recommended for adolescent beginners and instructors.

There is another method written by a piano educator who inherited Ortmann's style, the Abby Whiteside¹⁰⁴. She published three major books: *The Pianist's Mechanism* (1929), *Indispensable of Piano Playing* (1961), and *Mastering the Chopin Etude and Other Essays* (1969). The last two of the books were published after Whiteside's death.

In the book *Indispensable of Piano Playing*, many perspectives are similar to Deppe-Caland and Ortmann. The Deppe-Caland methods explain the relations between hand, wrist, forearm, and upper arm, while Ortmann's methods contain the insights concerning leverage. Whiteside fused their two methods in her book. However, the difference is that Whiteside believes the wrist's fulcrum is the finger, the forearm's is the wrist, the upper arm's is the forearm, the shoulder's

¹⁰⁴ Abby Whiteside (1881-1956) was an American piano educator.

is the upper arm, and the upper body's is the shoulder (Whiteside, 1961). As a matter of fact, as a fulcrum should be the joint of each locomotive organ, the fulcrum of each lever is the MCP joint, radioulnar joint, elbow joint, and shoulder joint.

Whiteside discussed the interrelation between muscle and skeleton. Skeleton structure is an element of resistance, and it helps muscles do more effective actions. She believes that the body is not only the fulcrum of the whole arm but also closely linked with rhythm. Additionally, she also thinks that good rhythm is the basis of score reading. Whiteside's research on rhythm far outweighed that of her predecessors. Rhythm is not only a musical concept but also a bond connecting the instrument to the performer. Therefore, she asserts that rhythm learning should be the first step for piano beginners in her method. (Whiteside, 1961)

On the other hand, in playing, Whiteside's research on the locomotive organs goes further than Ortmann's. Whiteside analyses playing mechanisms related to displacement, which includes horizontal, vertical, and in-and-out motions. (Whiteside, 1961). Her research can provide a more efficient way to play the piano because the mechanical principle can prove its efficiency from physical viewpoint. It is a kind of function of energy transformation, and the formula is $W = Fs \cos\theta$. The work W is done by the force F on its moved distance s . θ is

the angle of the motion. This physical relationship will be discussed in Chapter V with the contents of economical movements in piano playing.

In addition, Whiteside also discusses score memorisation. She refutes three ways to memorise music: only depending on ears, muscular memory, and sight memory. Whiteside thinks that musicians usually memorise scores through thinking and analysing music. (Whiteside, 1961) For students, ear and transposition training are efficient ways to score memorisation. Transposition practice requires good music theories as the base. Therefore, in Whiteside's method, knowledge of music theory is also necessary.

Generally speaking, Whiteside's method has many bright spots and unique points. In piano teaching, she also gives many suggestions, such as the idea that piano learning should start from ear training instead of finger practice, and those students then need to study physical movements and intellectual processes, followed by rhythm (Whiteside, 1969). Her purpose is identical to Breithaupt's, which seeks to achieve natural playing. It should not violate the basic kinematics and physiological functions of the human body but should comply with the physical rules of nature.

At the end of this chapter, I will discuss the last method, *The Technique of Piano Playing*, written by József Gát¹⁰⁵. He was a famous music educator in

¹⁰⁵ József Gát (1913-1967) was a Hungarian piano educator, who was a pupil of Béla Bartók.

Hungary who devoted his whole life to piano education, and also trained some famous pianists, such as Márta Kurtág¹⁰⁶ and Claudette Sorel¹⁰⁷.

The whole book integrates the basic principles of anatomy and physics, but in a way different from the previous methods. Gát's book does not merely describe these principles but also explains each technique through the physiological functions of the joints, body parts, and mechanics, and reveals the relationship between speed and displacement. Because Gát discussed these ideas in simple words, it is more accessible for non-scientists and music learners to read.

Firstly, Gát's book introduces the basic structure of the piano and simple anatomical knowledge and introduces Gát's technique – *Swing-Stroke*. He analyses the locomotive organs used in the swing-stroke (Gát, 1968). This technique runs through the whole book and is considered extremely important by Gát. Swing-stroke is a playing technique based on the lever principle and rotation. Therefore, to learn this technique, we need the correct sitting posture for the mechanical foundation.

As for the method of practice, Gát advocates practising with a slow tempo. He believes that practising in a slow tempo can enhance the fluency of music and

¹⁰⁶ Márta Kurtág (1927-2019) was a Hungarian pianist and educator, a wife of György Kurtág.

¹⁰⁷ Claudette Sorel (1932-1999) was a French American pianist and educator.

let the brain have more time to think. Moreover, forming unconditioned reflexes in practice can reduce errors and impel players to turn attention to cultivating musical ideas (Gát, 1968). From Gát's viewpoint, we can see that through the intervention of visible physical and physiological characteristics, the invisible physical and physiological characteristics can be changed to achieve the ultimate goal. However, it is almost the same as Matthay's method, which relies on the insights of psychology and neuroscience.

Secondly, Gát also mentioned most of the piano playing techniques and emphasises the use of the arm. However, when discussing finger position, he is considerate of the fact that the higher overtones fade more slowly. (Gát, 1968) Therefore, in order to ensure good sound, the fingers should stick to the keys as much as possible, just like the key is an extension of the arm. Raising fingers too high inhibits good sound. Consequently, no matter what technique, the finger should move with the shortest path to the keyboard. Through acoustic analysis, Gát refutes the high finger school's approach to tone production. At the same time, he considers the physiological characteristics of each finger explains the methods of each performance technique in detail. These approaches can help adolescent beginners in their learning.

At last, Gát thinks that physical finger exercise is helpful to the training of innervation of the nervous system, and can practise fingers without a piano; therefore, he offers physical finger exercises (Gát, 1968). Similar methods are

often used in modern piano education, such as Alexander techniques and gymnastics related to relaxing the body. As Breithaupt said, the first thing to learn in piano is how to relax the body. According to the questionnaire results in Chapter III, this statement is proved correct and vital for adolescent beginners.

In general, for adolescent beginners, Gát's method is worthy of reference and study. His realisation of individual personal differences makes his methods more efficient, and he has the foresight to understand the importance of cultivating and training the nervous system and minding one's state of consciousness in piano playing.

The representative methods of the 20th century that can be used for adolescent beginners I found have all been introduced. These methods focus not only on hand techniques as they did in the last two centuries but also on cognition and music itself. Therefore, they require students to practise cognitive abilities and acquire basic music theory knowledge. At the same time, pianists and researchers have applied principles of anatomy and physical mechanics to piano performance, and this makes it easier for teachers and students to understand such complex movements. On the other hand, these methods comprehensively describe piano playing techniques and have more profound explanations for

memorisation and sight-reading. For the development of these ideas, you can refer to the following *Table 4.5*¹⁰⁸:

¹⁰⁸ Hungary (HU)

Table 4.5

The summary of the 20th century's methods

	(FR) I. Philipp	(DE) R. M. Breithaupt	(US) O. Ortmann	(UK) T. Matthay	(US) W. S. Newman	(US) A. Whiteside	(HU) J. Gát
Body position		○		○	○	○	○
Hand position and movement		○	○	○	○	○	○
Wrist-use	○	○		○	○	○	○
Finger position and movement	○	○	○	○	○	○	○
Arm position and movement		○	○	○	○	○	○
Touch		○	○	○	○		○
Scale	○	○	○	○	○	○	○
Arpeggio	○	○	○	○	○		○
Intervals (double-notes, octave)	○	○			○		○
Chords	○	○					○
Rhythm	○	○		○	○		○
Phrasing		○		○			○
Ornaments	○				○		
Fingering		○			○		○
Shake (Tremolo)	○	○	○	○		○	○
Pedal		○			○		
Musical terms							
Note, Mark, Solmization							
Muscular, Relaxation		○	○	○		○	○
Weight-use		○	○	○			○
Sight reading		○			○		○
Skeleton			○			○	○
Memorisation					○	○	

*Made by the author

From *Table 4.5*, we can see that during the 20th century, some methods finally appeared in the United States, and that because its highly developed technology, a large number of scientific and empirical studies were carried out. The discussion of basic performance techniques focused on the scientific principles of movement in performance. They thought that only scientific and natural movements can quickly solve technical problems. Furthermore, more and more pianists and researchers thought that technique comes from musicality; therefore, the importance of music theory has been generally accepted.

This chapter can help us trace how music education evolved over the past three centuries. In that time, most musicians have been activated in educational and compositional fields. They have made achievements not only in piano education but also in music works that have been handed down for centuries. However, some musicians are known only as composers or pianists, such as Hook, Dussek, Steibelt, Hummel, Chopin, Liszt, Kalkbrenner, and Bartók; some musicians are more known as educators, such as Logier, Deppe, Breithaupt, Spencer, Ortmann, Whiteside, and Sándor; and some musicians are known as composers, pianists, and educators, such as Clementi, Bach, Czerny, and Leschetizky. It is not that they have made achievements only in the fields that they are famous for nowadays, but because the legacies they left in the long road of music development have attached certain stereotypes to them. First, I will discuss what lead to this phenomenon. Secondly, I will conclude what impact this phenomenon brings to our piano music education and predict future trends.

In the 18th century, Clementi and Bach created the glory of the Baroque and Classical periods, whereas, behind this glory, many musical works were composed for students to practise techniques. Although the purpose was for practice, it inadvertently led to many celebrated works. During this period, instrumental music was created more spontaneously, and people still only used musical instruments as a means to express music. Those etudes are all based on the original intention – conveying musicality while achieving a secondary purpose of finger practice.

In the 19th century, education and music seemed to develop separately. In terms of music, it goes without saying that everyone studied great works at that time. In terms of education, perhaps we are not so familiar with the practices of that century. Like the musicians and pianists mentioned in this chapter systematically made playing methods for the techniques required for diversified music expression. Nevertheless, a few musicians were famous for both music and education, such as Czerny. During this period, the structure of piano instruments significantly changed, and the richness of sounds improved beyond precedent. Empowered by increased capabilities of their instruments, musicians were able to create monumental works. However, these works appeared rapidly and in large quantities, requiring more sophisticated playing techniques and causing more students to become overwhelmed. Therefore, to help students acquire these techniques as fast as possible, more and more systematic playing methods and pedagogies have been bred. As a result, more musicians have become focused on

studying education, and the two paths of musical performance and education diverged. In the late 19th century, the scientific approach was inserted into piano method and pedagogy research. This approach includes physical mechanics, kinematics, and anatomy. However, the application of kinematics disappeared in the 20th century because the focus of research shifted to the nervous system.

In the 20th century, the separation of performance and education was more marked. The innovation of piano structure has slowed down, and music composition became more focused on expressing the possibilities of piano acoustics. Although some playing techniques are still undergoing innovation, the pace in this area has also slowed down. This brings opportunities for the research of playing methods and pedagogies. Those traditional methods can be evaluated scientifically, tested, and improved for teaching. The famous ones are weight touch, physiological mechanics in piano playing, and muscular synergy, and they were accepted generally among pianists and instructors. In the middle and late 20th century, neuroscience research was booming, leading researchers to focus on the relationship between the human brain and music, and simultaneously verifying the scientific accuracy of traditional methods through experiments.

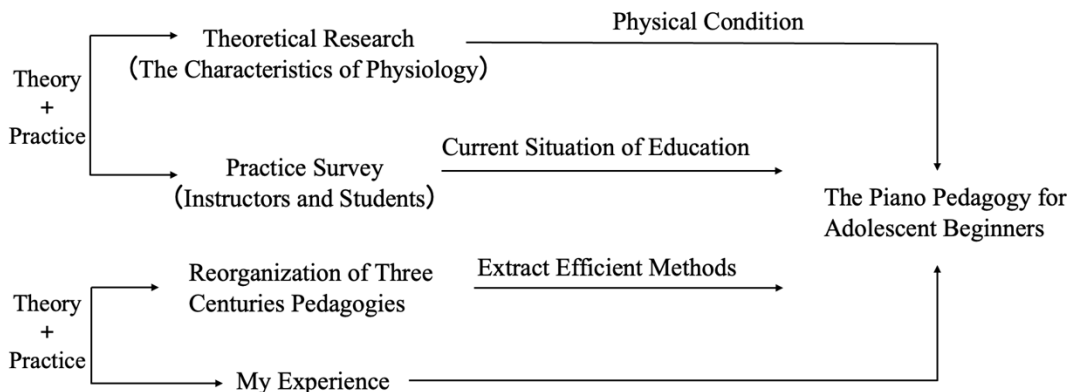
Piano education still uses traditional pedagogies nowadays. The instructor's strategy usually integrates traditional playing methods to pursue smooth and beautiful music expression. Even in some countryside, piano education still uses the 19th century's practice methods to pursue high finger technique blindly. This

impedes the application of efficient and scientific methods and pedagogies. Nevertheless, these traditional didactic works contain simple music, which can help adolescent beginners gain a deeper understanding of music theory in practice. However, the pieces we often use have to take into account the complex movement of fingers and the underlying musical concept, which is extremely difficult for those adolescent beginners who need to achieve specific goals in a short time. Therefore, we should rediscover those forgotten works to find suitable pieces, and then we can provide adolescent beginners with more beneficial choices.

In conclusion, we must admit that musical works with excellent musicality can always be handed down. However, as an instructor, you should not only find appropriate music works for students according to their characteristics and interests but also refer to current trends of music. Therefore, when instructors teach adolescent beginners, besides extracting available methods from the past three centuries' pedagogies and methods, they should also constantly evolve their strategies by consulting contemporary research and implementing it in practice, because practice is the sole criterion for testing truth.

Chapter V: The Piano Pedagogy for Adolescent Beginners

Chapter I has discussed the background and reveals the purpose of providing efficient and scientific piano pedagogies for instructors to help them guide adolescent beginners. In Chapter II and Chapter III, the theory and practice study of adolescent physiological characteristics reveals their internal body situation and the reality of education. It provides theoretical and actual evidence for the making of pedagogies; finally, I concluded the difficulties that adolescent beginners encounter when playing the piano. Then, I have reorganised the teaching methods of the past three centuries and extracted practical methods for adolescent beginners in Chapter IV. Moreover, as an example, according to my learning, practice, and teaching experience, also based on physiological, physical, and acoustic principles, I proposed a part of piano pedagogies for instructors to help them find effective strategies for adolescent beginners.



As for the contents of this chapter, it will put forward several problems related to adolescent beginners and draw further insights from the conclusions of the previous chapters. Traditional and modern methods will be compared, and the results of contemporary research into neuroscience and kinesiology will be mentioned. Moreover, this chapter will discuss the methods for basic techniques according to the principles of mathematic, physics, physiology and acoustics. The purpose is to bring some new and highly efficient strategies to instructors. This chapter include following parts: playing posture, body coordination and relaxation, how to read music, how to play scales, arpeggios and how to understand and practice finger independence, several supplements for daily practice.

5.1 Posture

Posture refers to the whole-body shape. In kinematics, the relative position of the head, trunk, limbs, and other body parts is called attitude, and the relationship between the anatomical plane¹⁰⁹ and the direction of gravity is called position (Nakamura, Saito, & Nagasaki, 2006).

Human beings living on the earth are always affected by the earth's gravity, and at the same time, in daily life, we are also affected by many other external forces. Human skeletons, muscles, and neural receptors maintain a particular

¹⁰⁹ Anatomical planes in human include the sagittal plane, the coronal plane, and the horizontal plane.

posture and resist external loads. (The forces interacting between skeletons, muscles, tendons, ligaments, and other types of tissue are internal forces.) The effect of these external forces is transmitted to the brain through the central nervous system, and then the brain sends orders to various locomotive organs to offset the resistance with a series of coordinated functions. For example, when you take the bus, you grab the bus handle, and suddenly the bus stops. However, because of the inertia, you will continue to move in the same direction at the original speed of the bus. At this time, to prevent damage to the body caused by the inertial force, your brain will give orders to the limbs and related locomotive organs, causing the muscles of the arm and other parts to contract to create a force opposite to the direction of inertial force, which can offset a portion of the inertial force. In this way, the body's speed can be reduced as fast as possible, and your body will avoid being injured. At the same time, friction also helps the body to slow down.

The example above first shows how forces in opposite directions can cancel out each other. Second, it illustrates how external forces can form an unconditioned response in the human brain, thereby rapidly stimulating the brain to unconsciously generate a protective response in the body. Third, the centre of gravity is closely related to the stability of body posture, the centre of gravity being the point where the weight of each part of the body balances with each other. Therefore, to keep an efficient posture we need the coordination of

multiple parts of the body. So, what are the conditions for a scientific and efficient posture?

This question can be mainly explained through the mechanical, physiological, and psychological aspects. From the mechanical aspect, in the stationary posture, the centre of gravity axis that balances the head, trunk, and limb segments is located in the support base, and the closer to the centre of the support base, the better the stability. From the physiological aspect, if the same posture is maintained for a long time, the volume of blood circulation relieving the muscles decreases, and muscle fatigue occurs. Therefore, changing the posture reduces muscle fatigue, even if it is difficult while doing movements. On the other hand, overstrain leads to strong muscle contraction which also causes stagnation of blood circulation. It should be noted that the posture in which internal organs such as those of the circulatory system, the respiratory system, the digestive system, and the urinary system are not excessively compressed or burdened is stable. Furthermore, in sports physiology, we should try to reduce energy consumption and improve motions' efficiency by using more minor muscles to achieve the purpose of action. From the psychological aspect, posture is strongly influenced by individual personality and emotions, and reflects the psychological state present at any moment (Nakamura, Saito, & Nagasaki, 2006).

Thus, it can be seen that posture is not only affected by external factors, which are related to mechanics, but is also influenced by internal factors arising

from physiology and psychology. Therefore, the human body needs to skilfully use mechanical knowledge and adjust the interior elements to maintain a good posture.

The quality of body posture control depends on neuromuscular performance (Kilby, Molenaar, & Newell, 2015).

...Neuromuscular system to functionally control and drive movements by an appropriate integration, coordination and use of sensory feedback, reflex activity, central motor drive, muscle recruitment pattern, muscular excitation-contraction coupling, and energy availability...¹¹⁰

Therefore, the neuromuscular system is related to movement and posture and the sensitivity of the nerve system, the relaxation of the body, and the efficient use of locomotive organs. Moreover, all these factors are particularly important in efficient piano performance.

On the other hand, as I mentioned in Chapter II, the proprioceptive senses are related to body position and movement. There are many receptors in the skin, muscles, and joints of the human body. These receptors are used to sense pain or external stimuli and sense the movement and position of motor organs. Moreover,

¹¹⁰ Faude, Oliver and Lars Donath (2019) “Editorial: Neuromuscular Performance During Lifespan: Assessment Methods and Exercise Interventions.” *Frontiers in Physiology*, 10:1348, Doi: 10.3389/fphys.2019.01348.

proprioception is a development where the precision improves with age, while its receptors' sensitivity decreases with age. Therefore, a correct posture becomes particularly important for adolescent piano beginners. Meanwhile, teachers need to remind them all the time to form a good performance posture.

Ludwig and his team investigated whether body posture can be enhanced by improving neuromuscular performance in adolescents. They divide objects into three groups: TR18 (training until the age of 18 then stopping), TR20 (uninterrupted training until the age of 20 years) and CON (non-exercising control group). This research has found a significant improvement with posture positions, including the changes of stretch and body perception among TR18 and TR20. Moreover, they found that when muscles are controlled purposefully, conscious posture correction is enabled. And they concluded that through adequate training, habitual posture could be improved as well. (Ludwig, Kelm, Hammes, Schmitt, & Fröhlich, 2018) However, this process needs an excellent proprioceptive perception of the joint positions. Therefore, the proprioceptive perception of the body position should be trained regularly.

Based on these conclusions, adolescent beginners can improve their posture and joint positions through systematic practice, and furthermore, the precise perceptions involved in playing can be improved. In the following words, I will first discuss how the playing posture develops and then talk about reasonable and scientific playing postures according to the piano methods mentioned in the last

chapter. Secondly, I will make a mechanical analysis of the performance of body and hand postures to evaluate their effectiveness. Finally, I will put forward some suggestions for piano playing posture by considering the characteristics of adolescents discussed in Chapter II.

Initially, in the last chapter, I discussed three centuries of piano methods and pedagogies. I found there are many methods and strategies for piano practice that can be used for late beginners. At the same time, for comparison I have assembled the following performance postures recommended according to the past pedagogies discussed in Chapter IV, it includes fingers, hands, wrists, and arms. And it is summarised in chronological order.

Diruta (1622)

- Sit opposite to the middle of the Organ
- Do not make gestures or movements with the body, but sit with body and head erect and poised
- Let the arm guide the hand so that the hand is always level with it, neither higher nor lower
- Fingers should lie evenly on the keys, somewhat curved
- Fingers should press the keys rather than striking them; the fingers being lifted as the keys rise
- Keep the hand relaxed and light

Couperin (1717)

- The distance from the keyboard when sitting down is about 9 inches to the waist for adults and less for young people; it depends on the age.
- Sit opposite to the middle of the keyboard.

- Turn your body slightly to the right, and do not put your knees too close together
- The appropriate age for a child to learn keyboard is 6 to 7 years old
- Do not raise your wrists too high
- For soft playing, bring your fingers closer to the keyboard

Johann Sebastian Bach (Forkel, 1802)

- Fingers bent, extremities poised perpendicularly over the keys and parallel to them
- Fingers cannot fall or be thrown upon the notes
- Move only the top points of fingers
- Fingers rest upon the keys
- Bach recognized the differences in fingers

Clementi (1803)

- The hand and arm should be held in a horizontal position
- Fingers are placed over the keys and always ready to strike
- Fingers are bent, more or less in proportion to their length

Graupner (1806)

- The hand and arm should be held in a horizontal position
- Fingers are placed over the keys and always ready to strike
- Fingers are bent, more or less in proportion to their length

Hummel (1828)

- Sit opposite to the middle of the keyboard at a distance of 6~10 inches
- The seat should be neither too high nor too low

- The body is held upright, and the elbows are turned towards the body, yet without pressing against it
- Regarding muscles: Arms and hands should be held without any stiffness
- Hand position is rounded, resting on the keys naturally and without effort
- Strike the keys with the middle of the tip of the fingers. The thumb may form a horizontal line with the little finger on the keyboard
- The thumb touches the surface of the keys lightly with the edge of its top joints and is always ready to pass under the fingers
- Fingers should move with lightness and freedom and not be lifted too high from the keys

Czerny (1839)

- The seat must be placed opposite the middle of the keyboard
- The ends of the elbows may be about an inch higher than the upper surface of the keys, for a low seat impedes and fatigues the hands
- The position of head and chest should be upright, dignified and natural, avoiding any movement of the head
- Feet should rest near the pedals but without touching them
- The wrist must neither be bent downwards nor upwards
- Fingers are bent inwards slightly
- The knuckles of the bent fingers must form a straight and horizontal line
- Avoid bending the other fingers (except the thumb) inwardly
- All fingertips, as well as the thumb in its natural outstretched position, should form a straight line
- Arms hang freely by their natural weight from elbow

Latour (1832)

- Sit with ease opposite the centre of the keyboard, at a moderate distance
- Play without any motion of the head moving up and down
- The wrist is held almost at the same level as the forearm, with knuckles kept almost flat

- The three extended fingers are slightly bent with the little finger creating a straight line with other fingers.
- The thumb should be a little bent
- The arm should not be kept too close to the body

Herz (1838)

- The seat is proportioned to the pupil's height and that of the keyboard
- Sit upright and in the middle of the piano
- Feet are placed opposite the pedals
- Hands are rounded
- Fingers are bent without stiffness, allowing each finger particular and independent motion
- The part of the arm below the elbow should be horizontal
- The arm should not move if the hand does not change its position

Bertini (1848)

- Using pictures to illustrate correct body position
- Sit in front of the middle of the keyboard with the body held erect
- The wrists should be turned outward, and with arms forming a straight line (not too high or too low)
- The keys are struck with the extremities of the fingers, but not with the nails
- The wrists and arms should form a straight line
- Strike the keys from the fingers, from the wrists, or from the forearm

Spencer (1853)

- Place the fingers in as straight a line as possible with the keys they are upon
- Raise the whole hand about an inch above the keys, keeping each finger in line with its key, without stiffness
- Always keep the fingers parallel with the keys

Richardson (1859)

- The seat should be the correct height, with the player sitting opposite the middle of the keyboard
- The head and upper part of the chest is neither stiff nor bent (body upright)
- The hand does not rise upward, nor is it bent
- Fingers bend, while one finger strikes the key with the other fingers are kept near the keys, but consistently bent and raised somewhat in the air
- The thumb always strikes the key with its narrow external surface and is a little bent
- The forearm should form a perfectly straight, horizontal line
- The arms hang freely without being pressed against the body

Plaidy (1852)

- Sit opposite to the middle of the keyboard, the seat at a height allowing the elbows to be a little above the level of the keyboard
- Avoid motions of the head, shoulders, and upper body
- The centre of gravity of the hand in playing should fall inwards
- The wrist is neither perceptibly raised nor lowered. It should lie at the same level as the hand and arm
- Regarding the fingers: the knuckles must neither be raised nor bent inwards; the fore part of the fingers must be gently rounded with the 4th and 5th fingers a little more extended. And the thumb should be stretched horizontally
- The arm should be kept close to the body, though without touching it

Pauer (1877)

- Sit before the middle of the keyboard with the music stool firm and secure
- Hand position is illustrated with pictures, the centre of gravity of the hand when playing should fall towards the thumb
- The wrist is neither perceptibly raised nor lowered and is held at level with the hand and arm
- Knuckles are neither raised to form a hollow in the hand nor bent inwards

- The forepart of the fingers must be gently rounded
- The 3rd and 4th fingers are not as rounded as the others but should be a slightly more extended
- The thumb is stretched horizontally and is never permitted to hang down or to rest upon the keyboard
- Arm movements should be graceful and easy

Leschetizky (1902)

- Keep nails short
- A rounded hand position is illustrated
- The wrist be held somewhat lower than the knuckles
- Tip joints of fingers fall vertically on the keys
- Fingers are unequal in length
- The upper arm does not follow the wrist-motion

Philipp (1908)

- The wrist is held loosely and relatively low
- The knuckles are rounded
- The fingers are curved, with only the tips striking the keys
- The nails should be kept short
- The two joints of the thumb are bent towards the other fingers

Breithaupt (1909)

- The height of the seat is determined solely by the size and proportions of the player's physique, more especially by those of the upper and lower body
- The muscles of the lower body and the abdomen must be relaxed, allowing the body freedom of movement
- The player sits opposite the centre of the instrument
- A firm ball shaped hand bridge (arch) should be maintained.
- A yielding wrist is required

- Fingers should be straightened out slightly to support the weight bone by the palm, arched to form a bridge
- Knuckle-joints of fingers do not bend in creating tension
- The arm should hang loose and is inactive in the shoulder joint, and it should be supported by the hands or fingers

Matthay (1932)

- Avoid sitting too close to the instrument, with upper arm straight down from the shoulder
- Sitting neither too high nor too low
- Do not relax your body completely, keep it erect
- Avoid kinking the knuckles of the hand; the arch shape is mechanically more effective than any other position
- Allow the wrist to turn slightly outwards
- Flat and bent fingers are discussed
- Avoid using upper arm rotatory movements as they are a waste of energy and is also distinctly inelegant. Avoiding using the arm to help the fingers to play the notes

Newman (1956)

- His illustration is included to show body pliability and adaptability
- The bench is not too be high or too low; sit on the front half of the bench about 10 inches, from the surface of the keys down to the compressed top of the bench
- Bad eyesight influences position
- The edge of the knees should be no more than an inch or two under the keyboard
- The feet rest on the “balls” of the outer pedals
- Hand function is the converse of finger function
- Do not play by impulses from the arm
- Flat-finger playing is best achieved using the small muscles (lumbricals) of the hand

- The elbows are held several inches out from the body; elbow tips are always on a level with the fingertips if the performer is sitting at the right height

As can be seen from above, from the 18th century to the 20th century there has been a point of consensus concerning body posture, which is the idea that the piano stool must be adjusted to an appropriate height, not too high or too low. However, scientific grounding for this was not provided until the end of the 19th century. Deppe conducted a practical analysis, and he recommended that those with a large body and long arms should sit lower, and those with short bodies and thick-set arms should sit higher, which is identical to Breithaupt's prescription (Breithaupt, 1909). According to the lever principle, the arm can be regarded as a lever and the elbow as the fulcrum. Assuming that the height of the piano keys and the distance between person and instrument remains unchanged, if the person with long arms sits high, the distance of the torque gets shorter, which means the elbow will move to the back of the body, which makes the lever movement harder and less flexible. Adolescent beginners are not like children who cannot reach the ground with their feet. Hence, they should adjust the seat height to place their right foot close to the damper pedal, and their left foot should support the body and stabilise the centre of gravity. Additionally, Shin and La (2005) proved that a performer sitting in a high seat could produce a significantly large force with the deltoid muscle, and they indicated that the performer should sit erect and with a levelled forearm.

Consequently, regarding the height of the seat, instructors need to think about not only the ratio of the student's height, but also the length and thickness of the arms; instructors should measure the optimal seat height for adolescent beginners by using the principle of leverage.

The past methods have mentioned that players should sit erect, and Chapter III also concludes that some late beginners have a common problem with posture, which is the "hunchback" position. According to the conditions required for a stable centre of gravity mentioned above, at first, students need to set the vertical axis from the head to the hips, with the hips acting as a fulcrum. The vertical axis should be perpendicular to the horizontal axis formed by the shoulders, which means the line between the two shoulder joints and the line from the head to the hips form a shape of the cross. Here is a method for players to check whether they are sitting upright: First, put hands on the ischium, and then sit down slowly. At this time, do not move your hands; and they should be pressed on the piano stool by your hips. When the ischium feels a little pain because of the pressure of the hands, pull the hands out. At this point, the player's body is not only straight and relaxed, but the centre of gravity is just in the middle of the body. Moreover, teachers should note whether the head (or neck) and chest of students remain relaxed. Students should avoid unnecessary movements.

However, in any sport, or in the habitual actions of daily life, it is impossible to complete a motion only by a specific locomotive organ of the body. In other

words, all movements occur due to the complementary coordination of the body's locomotive apparatus. It is the same thing with piano playing. Since the end of the 19th century, it has been suggested that students better use the whole body and learn coordination. Therefore, rather than saying that the head, shoulders, and upper body do not participate in movement, it is better to say that keeping them in a relaxed state assists hands in completing the performance task. In addition, to ensure the stability of the centre of gravity, the left foot should be bent 90 degrees, the sole should fall on the ground, muscles should be relaxed, and the waist should be supported. All these measures can ensure that the centre of gravity of the body falls on the vertical axis of the body.

In the past three centuries, most methods discussed finger position, which they said should be bent or flat. Bach asserted that the strength of ten fingers should be trained equally, while Chopin believed that it is not necessary to deprive each finger of its unique personality. Their viewpoints affected ideas about finger position during their time. However, there are still wise insights from teachers like Clementi, Latour, Matthay, and others who believe that the finger position should be adjusted according to the condition of each player. They advocated bending the three longer fingers. For the small finger (the 5th finger), its tip should be kept in a straight line with other fingers' fingertips; hence it should be straightened. From my perspective, the finger position does not have an absolute correct position, but there is a prerequisite that must be confirmed, which is the third joint (MCP joint) of the hand needs to be bent. This means the

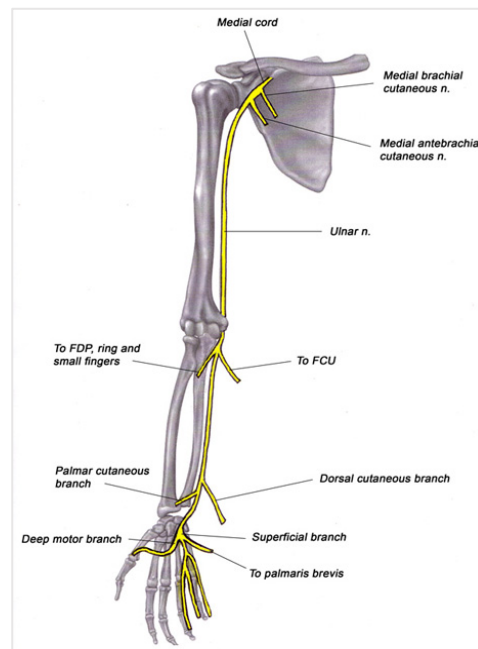
hand must keep an arched shape, The value of the arched hand will be proved scientifically below.

I want to talk about positions – firstly, the wrist and arm positions. It can be seen from the summaries of the past methods that they did not mention wrist position until the 19th century, but Couperin is a unique case because he mentioned a little bit about wrist position; this is rarely seen in that time. After Couperin, most people generally thought the wrist should form a straight line with hand and arm; also, several methods proposed that the wrist should be turned outward a bit, and this is mentioned by the Caland-Deppe method (see *Figure 4.7*). This method asserted that the fifth finger should be in line with the ulna as much as possible. On a point of anatomy, a nerve we call the ulnar nerve extends from the shoulder to the little finger, and it is one of the three primary nerves in the human arm (Bertelli & Tavares, 2018) (Davis & Kane, 2020). The ulnar nerve plays the role of controlling the movement of the little finger and a half of the ring finger; meanwhile, it also controls most of the small muscles in our hand (see *Figure 5.1*)¹¹¹.

¹¹¹ Neurology Needs, Ulnar nerve. Retrieved from <https://www.neurologyneeds.com/neuroanatomy/peripheral-nerves/ulnar-nerve/> (Accessed on May 31st, 2021)

Figure 5.1

Ulnar Nerve



Source: Neurology Needs, Ulnar nerve. Retrieved from <https://www.neurologyneeds.com/neuroanatomy/peripheral-nerves/ulnar-nerve/> (Accessed on May 31st, 2021)

In piano playing, if the player bends the elbows or plays with a sunken wrist joint, risk to creating pressure on the ulnar nerve because it can lead to ulnar nerve entrapment¹¹². This is one of the widespread injuries among modern pianists. However, turning the wrist outwards can lead the elbow outwards as well, reducing ulnar nerve compression, and thereby maintaining flexible movement

¹¹² Ulnar nerve entrapment occurs when the ulnar nerve is compressed. Compression occurring at the elbow is called cubital tunnel syndrome, while that occurring at wrist is called ulnar tunnel syndrome.

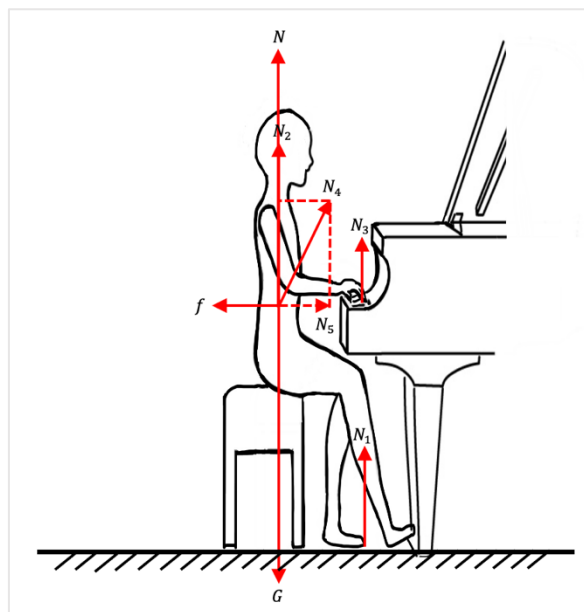
of the fingers and avoiding finger injuries. At the same time, this is also why it is necessary to avoid keeping too close to the body during piano playing.

Although the development of musical instruments has had an impact on playing posture, the principles of overall body support remain unchanged. Since the birth of the first piano in 1709, piano playing posture has been gradually paid more and more attention. The emphasis has shifted from fingers to the whole body. Piano playing is more and more regarded as a whole-body movement. However, contemporary piano methods are not like Bach think that playing with ten fingers only, but Bach laid the foundation for finger use, not like Czerny, only working on the flexible fingers, but he has contributed to valuable piano practice methods. Additionally, high fingers are no longer emphasised as a central technique but are considered is an occasional tool for bringing out some timbre's expressions. Accordingly, from these methods and schools, we have used scientific assessment to realise the essence of piano performance more thoroughly today. For example, Breithaupt's weight-touch is based on gravity; Ortmann's understanding of the lever principle in body structure helps the player understand the mechanical movement and improve movement efficiency; Matthay, Newman, and other modern researchers have mapped the entire body's usage of locomotive organs, and they injected new vitality and expressive power into the development of the playing posture.

The effectiveness of well-known postures used in modern piano teaching, such as sitting upright and using arched hands has been proved in this research. Many external forces act on the players in piano playing. I did the mechanical analysis is shown in *Figure 5.2*, and I have calculated the relationship between these external forces and piano sounds. From the results, we can find a natural and scientific playing posture.

Figure 5.2

Mechanical analysis when playing the piano



*Made by the author

H : instantaneous height of the centre of gravity

H_0 : initial height of the centre of gravity

H_1 : height variable of the centre of gravity

v : instantaneous velocity of displacement of the centre of gravity

v_0 : initial velocity of displacement of the centre of gravity

v_1 : velocity variable of displacement of the centre of gravity

t : time

F : the sum of external forces on the body

M : mass of the player

N : the sum of normal forces on the body

N_1 : the normal force of the ground on feet

N_2 : the normal force of bench on hip

N_3 : the normal force of piano on hand

N_4 : the slop direction normal force of bench on the body

G : gravity

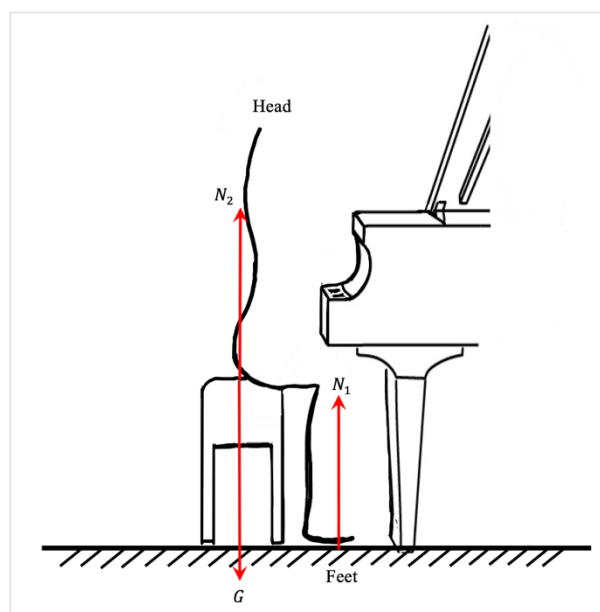
f : friction

$$\begin{aligned} H &= H_0 + H_1 \\ &= H_0 + \int v dt \\ &= H_0 + \int (v_0 + v_1) dt \\ &= H_0 + \int v_0 dt + \int v_1 dt \\ &= H_0 + \int v_0 dt + \iint \frac{F}{M} dt dt \\ &= H_0 + \int v_0 dt + \iint \frac{N - G}{M} dt dt \\ &= H_0 + \int v_0 dt + \iint \frac{N_1 + N_2 + N_3 - G}{M} dt dt \end{aligned}$$

As seen from the figure above, we can find that when $N = G$, the player is balanced vertically. According to the analysis above, the relationship between the height of the centre of gravity and the external forces can be seen, which is the displacement of the centre of gravity related to all the external forces that act on the players. These external forces and the displacement of the player's centre of gravity corporately and indirectly complete the movements of piano playing, which is to say, the sounds produced by the piano player are an extension and another form of expression of those external forces in space. In other words, the influence of external force on piano playing posture has been proved. Therefore, posture as the carrier extends and expresses the piano sounds to the space. Next, the mechanical analysis is used again to deduce the specific relationship between sitting posture and piano playing.

Figure 5.3

Mechanical analysis of sitting upright



N_1 : the normal force of the ground on feet

N_2 : the normal force of bench on hip

G : gravity ($G = mg$)

m : mass of the player

g : gravitational acceleration

Anatomically, when the human body sits upright, its spine forms an S-shape (see *Figure 5.3*); this shape helps cushion the mechanical pressure, which also plays a role in protecting the brain. In playing the piano, the arm moves with the shoulder joint as the centre. The force transmission path is the shoulder – spine – hip – leg – foot – ground, and another path is the shoulder – arm – hand. In this case, the player should sit erectly. Thereupon the following equations are satisfied:

$$G = N_1 + N_2$$

$$mg = N_1 + N_2$$

$$W_G = mgh$$

$$W = (N_1 + N_2)s$$

h : displacement of the centre of gravity s : displacement of N_1 and N_2

W_G : work done by gravity W : work done by N_1 and N_2

When the player raises the arm, the body's centre of gravity will shift upwards, the work done by gravity (W_G), and the direction of displacement is opposite to

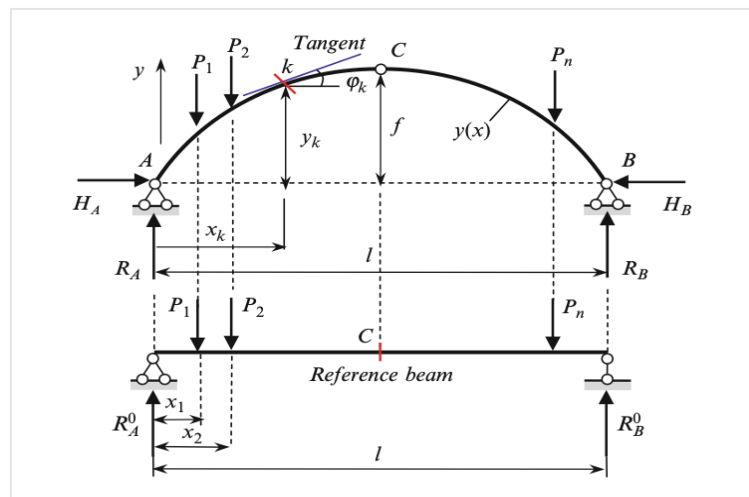
gravity; hence, gravity does negative work. On the other hand, gravity does positive work when the arm falls back to its original position. Therefore, if the two movements above are regarded as one whole movement, the gravity does not work, which means it achieves economical playing. Consequently, the effectiveness of the weight-touch method has been proved, which demonstrates that in piano playing, the arm movement needs to depend on gravity; if the arm uses too many extra external forces, the player will feel fatigued quickly because they have to do too much work.

The mechanical analysis and results above are based on the condition that the player is sitting upright. However, when the player is sitting with a problematic posture, such as a “hunchback,” the sounds get worse and lead to low-efficiency playing. There are two reasons: when hunching the body, the spine and shoulders deviate from the original mechanical balance axis (the gravity axis), and the spine becomes weak to cushion against external forces. Thus, other internal forces are needed to offset those external forces. Another reason is that when raising the arm, not only the arm does work, but the shoulder also does work. Therefore, the forces cannot be directly transmitted from the shoulder to the various locomotive apparatuses along the transmission path mentioned above. In other words, part of the force is lost on the transmission path. Consequently, maintaining a straight sitting posture is extremely important for efficient piano practice because it will significantly save energy and achieve economical performance.

Furthermore, the arched hand (or hand bridge) is a significant element of posture in piano playing. Before discussing hand bridges, it is necessary to mention arched bridges at first because the mechanism of a hand bridge is similar to that of an arch bridge, especially the three-hinged arch bridge, which has three hinges A, B, and C in the arch.

Figure 5.4

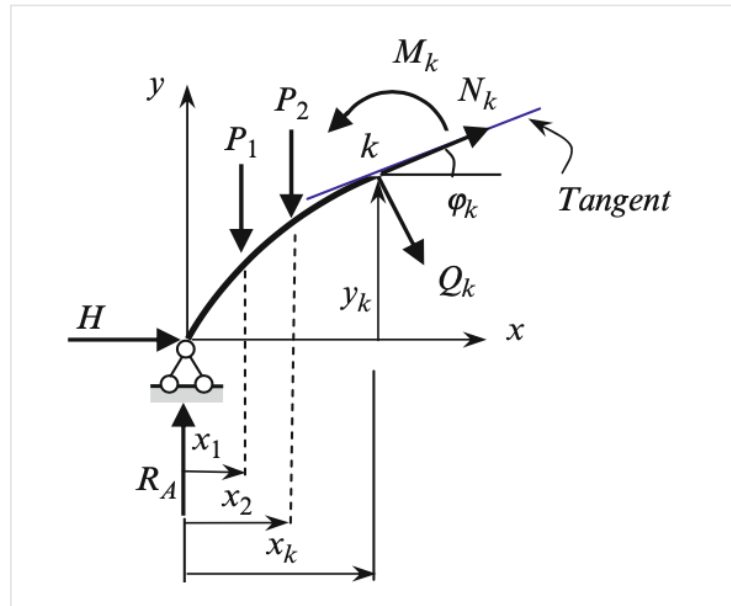
Three-hinged arches, the reaction of supports



Source: Karnovsky, Ignor A. (2012) *Theory of Arched Structures: Strength, Stability, Vibration*. Berlin: Springer. p. 58.

Figure 5.5

Reactions of supports and internal forces



Source: Karnovsky, Ignor A. (2012) *Theory of Arched Structures: Strength, Stability, Vibration*. Berlin: Springer. p. 59.

In *Figure 5.4*, $H_A = H_B = H$ is horizontal thrust, R_A and R_B is vertical reactions (left and right) to carry the vertical load, f is arch height, C is the hinge of the arch, M is bending moment, k is a point on the arch, φ_k is the angle between the tangent and horizontal.

According to the calculations, we can use the following equation to explain the interactions between horizontal thrust and arch height

$$H = \frac{M_C^0}{f} \quad (1)^{113}$$

The equation reveals that thrust H is in inverse proportion to arch height f .

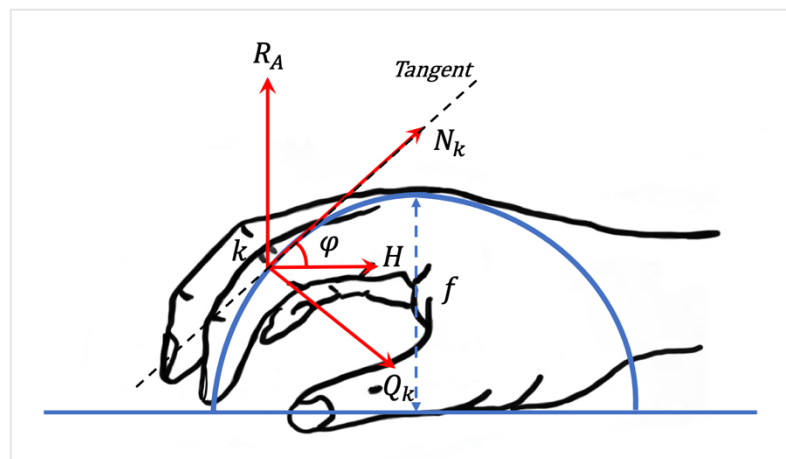
In *Figure 5.5*, N_k is axial force, Q_k is shear force, P are forces that are located at the arch. In order to understand the relationship between φ_k , N_k , Q_k and H , the following equations have been defined

$$Q_k = Q_k^0 \cos \varphi_k - H \sin \varphi_k$$

$$Q_k^0 = R_A - \sum_{left} P \quad (2)^{114}$$

Figure 5.6

Mechanical analysis of hand bridge



*Made by the author

¹¹³ *Ibid.* p. 59.

¹¹⁴ *Ibid.* p. 60.

The three-hinged arch bridge is similar to the hand bridge. I made the analysis shown as *Figure 5.6*. A, B, and C of the three-hinged arch bridge in the hand bridge are the fingertips, wrists, and MCP joints. Therefore, the equations defined above can also analyse the hand bridge. Equation (1) illustrates that when the MCP joint is too low, it will cause the horizontal thrust H increase, which causes the fingertips to touch the keys with more difficulty. Therefore, the height of the MCP joints should be adjusted according to the fingertips to ensure the player can touch the keys by using fingertips. Concerning shear force and axial force, according to equation (2), when playing the piano, if the tangent coincides with N_k , the frame of the hand will remain stable; however, if the tangent deviates from the original N_k direction and moves closer to the vertical axis, the angle φ gets larger, but now it should keep touching the keys using fingertips; thus, the horizontal thrust remains unchanged. Hence, the shear force Q_k becomes weaker, which will quickly cause the DIP joint to arch out of the palm, and the result is touching the keys by nails. Conversely, if the tangent is close to the horizontal axis, the angle φ gets small, and it causes the shear force Q_k to become stronger, which will cause the DIP joint to fold inwards toward the palm, which is called folding fingers in piano playing.

However, Matthay and Mikimoto suggested how to avoid folding DIP joints. Matthay (1932) advised that students should not raise their fingers too high and should drop fingers without too much energy from the hand and arm when playing the piano. Moreover, Matthay (1932) thought the finger should left the

key to a suitable height and drop the finger uncurved or less bent, let fingertips fall vertically. On the other hand, Mikimoto thinks that the DIP joint and fingertip should be fixed at first, and when fingers fall, the muscles of the hand (lumbricals and interosseous) should be used (Mikimoto, 2010). The two methods share a common point in that both use the fingers like they are gripping an object. As I mentioned in Chapter II, there are no muscles in the fingers; the energy of the fingers comes from hand and arm muscles.

Finally, As Leschetizky said, if students only focus on hand and finger practice,

*through them the fingers finally acquire exquisite sensibility, and the wrist also soon learns to follow the movements of the fingers. The arm, to be sure, remains a clumsy fellow, always having to be guided lest he throw fingers and wrist off the track by faulty movement.*¹¹⁵

In this part, the sitting posture, the position of arms, hands and fingers are discussed. Sitting posture and hand position are analysed and calculated scientifically to bring more reasonable suggestions to adolescent beginners so they can avoid unacceptable habits and injuries. A natural, scientific posture is vital for highly efficient and economical playing. Based on the correct playing

¹¹⁵ Brée, Malwine. (1902) *The Groundwork of the Leschetizky Method*. New York: G. Schirmer. p. 80.

posture, I will discuss how to coordinate body locomotive organs, which is also a severe difficulty for adolescent beginners reflected in the research findings in Chapter III.

5.2 Coordination and Relaxation

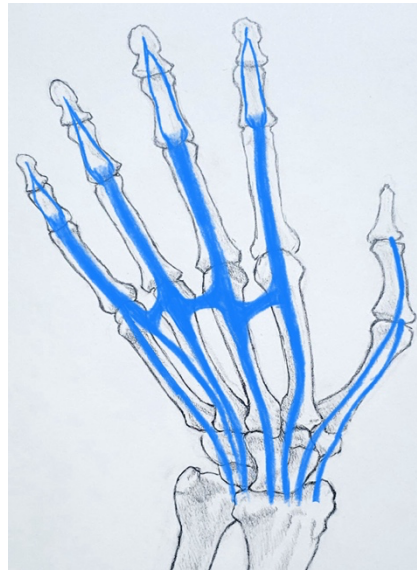
The questionnaire surveys in Chapter III found some problems related to using the body among adolescent beginners. According to the results, body balance is a conspicuous problem, and adolescent beginners cannot use their locomotive apparatus in piano playing naturally and smoothly. These problems contribute to the problems of body coordination and muscular synergy.

It is necessary to consider coordination and body posture as a whole because a good posture is a prerequisite to highly efficient coordination. In our daily life, every movement is completed by not only one locomotive organ, but by different kinds of organs cooperating together. These organs are the musculoskeletal system, including the skeleton, muscles, tendons, ligaments, joints, and multiple proximal and distal motor organs. The skeleton shapes posture, joints guide the direction of movements, and muscles of different sizes and shapes provide energy for movement. Tendons connect muscle to the skeleton, and their primary function is to transmit force; ligaments create stability in joints and hold the internal structures together.

In piano playing, the skeleton enables the player to form a good posture and can be controlled to produce structures such as the hand bridge; joints guide players to successfully complete various techniques, such as keystroke, tremolo, and octaves; muscles provide energy and endurance for piano playing; ligaments connect each finger (see *Figure 2.3*) to build bridges and pathways, which can help transmit forces and provide a physiological basis for weight transfer; tendons provides tension to the fingers and stability for knuckles, and affect finger flexibility and independence (As shown in *Figure 5.7* that I drew). Undoubtedly, piano playing requires not only fingers but also the participation of other locomotive apparatuses. Hence the performer must form an awareness of interrelationships in their mind. Additionally, the control centre of these coordinated motions is the central nervous system, which means that in performance, besides the participation of the motor organs, the nerve-level activities such as auditory perception, haptic perception, and visual perception are also involved.

Figure 5.7

Tendons of the left hand



*Made by the author

Generally speaking, coordination results from using both hands and brain simultaneously, and the other parts of the whole body assist it. Nevertheless, we still often hear about many cases of injury among piano players. Sakai (2002) found six injuries that pianists are most vulnerable to: tenosynovitis or tendinitis, enthesopathy, muscle pain, finger joint pain, neurological disturbance, and neck or scapular pain. There are diverse reasons that can lead to these injuries. For example, playing with unrelaxed wrists, elevated shoulders, and longer practice time bring a higher risk of musculoskeletal disorders, which all have an unavoidable relationship with the coordination of body locomotive apparatus. The relationship between wrist posture and motor coordination is essential. The study found that the coordination function of the forearm muscles and wrist can

stabilise the wrist joint, and the weight-touch can reduce the risk of musculoskeletal disorders (Allsop & Ackland, 2010). Furthermore, it showed that under the coordination of the body itself, external forces can also be a positive factor to help players achieve performance more efficiently.

Weight-touch has been introduced in the previous chapter, and its upgraded version is weight-transfer. In general, weight playing uses the weight of the hands or arms to play, which is to use gravity to play. It is not a way to practise finger independence, but to learn to relax them. Therefore, weight-touch exercises can help the arm relax, and it will also help students to become acquainted with coordinated functions.

In China's piano teaching, there is an exercise as follows: First, the teacher raises one of the student's arms. Then, after the teacher removes his hand, the student is asked to let their arm fall freely onto the keyboard with the 3rd finger extended. At the moment the finger touches the key, the student will feel the arm vibrate up and down, which is caused by inertia. At this time, it is proved that the arm is in a completely relaxed state, and all its weight is carried on the hands and fingers. This exercise is called "arm drop" or "arms fall," and it is recommended to be taught in the first lesson. Similar approaches to this exercise are also mentioned by Matthay, Breithaupt, Tetzl, Mikimoto, and Sándor.

Matthay (1932) noted the six functions of the arm. 1) Weight transfer and arm vibration. Weight transfer means to transfer force from the shoulder to the fingers or from fingers to fingers. The reaction force causes arm vibration from the keys through the fingers, hand, and wrist when the fingers are running fast; this vibration counteracts the reaction. Matthay believes that *all successful agility passages must necessarily be played either as “arm vibration” or as “weight-transfer” touch.*¹¹⁶

2) Forearm rotation is a master key, which can solve almost all playing techniques, such as trills, tremolos, arpeggios. I will explain it by using the musical figures shown below:

Example 5.1 M. Clementi’s *Introduction to the Art of Playing the Pianoforte*, Op.42, Leçon XXVIII, mm. 1-5. Leipzig: C. F. Peters. Arranged from J. Haydn’s Piano Trio in G major, Hob.XV:25, the 1st movement.

The image shows a musical score for a piano exercise. It is labeled '46' and 'Presto.' The title is 'LEÇON XXVIII' and 'Rondo de D! HAYDN.' The score is in 4/4 time and G major. The right hand part is a rapid sixteenth-note passage with fingerings: 3 4 5 3 4 2 3 1 4 2 3 5 1 3 4 5 3 4 2 3 1 3 1 2 4 1 4 4 1. Red arrows point to the first and second measures of the right hand, labeled 'Right' and 'Left' respectively, indicating arm vibration techniques.

¹¹⁶ Matthay, Tobias. (1932) *The Visible and Invisible in Pianoforte Technique*. London: Oxford University Press. p. 28.

Example 5.2 J. N. Hummel's Piano Sonata No.5, Op. 81, the 1st movement, mm. 24-26. Braunschweig: Henry Litolff's Verlag.



In the music examples above, “left” represents the arm rotation to the left, which is the direction of the thumb inward; “right” represents the arm rotation to the right, which is the direction of the five fingers outward. Figuration such as Alberti-bass or the broken thirds scales shown in these examples can use arm rotation. However, Matthay noted that the rotation movement cannot be used for rapid passages because there is no more time to complete the rotation; instead, players should use more finger motion to play each note but with a disguised and hidden rotation of the forearm (Matthay, 1932). In my perspective, the rotation utilisation in a fast tempo should be related to the hand size. Big hands pianists maybe only use fingers, but like me, the small hands, using rotation properly in a fast tempo could help wrists relax. Actually, it is a good way to play such as Chopin's Etude Op.25 No.11 by connecting rotation with fingers running according to the methods that I received.

Summing up 1) and 2), the arm needs to be comparatively lighter so that the fingers can move freely and flexibly without pressure in a rapid passage. Also, in this way, the tone will be lighter and more transparent. Nevertheless, forearm

rotation is needed to help complete the whole process. Actually, you can see your wrist is rotating slightly in this case. Therefore, arm vibration, weight transfer, and forearm rotation are coordinated with each other when playing the piano.

The other four functions are to be used selectively. 3) Forearm weight is available for dynamic change and playing chords; 4) The whole arm weight is used to play cantabile; 5) Forearm down-exertion with upper arm weight is used to make loud and wild sounds; 6) Upper arm forward-drive actually is more of a negative effect because it can produce bad sounds; therefore, this is not recommended for adolescent beginners (Matthay, 1932).

The prerequisite for using the arm techniques mentioned above is to play with relaxation, and Matthay provided a related exercise that is an upgraded version of Breithaupt's. The exercise from Breithaupt (1909) to relax the arm is to put the hand with a bridge shape upon the keyboard at first, then raise the whole arm, then drop it down and stand on the key firmly by the third finger (see *Figure 5.8*),

Figure 5.8

Weight touch position



Source: Breithaupt, Rudolf Maria. (1909) *Natural Piano Technique Vol. 2: School of Weight-Touch-Natural Piano Technic*. Leipzig: C. F. Kahnt Nachfolger. p. 11.

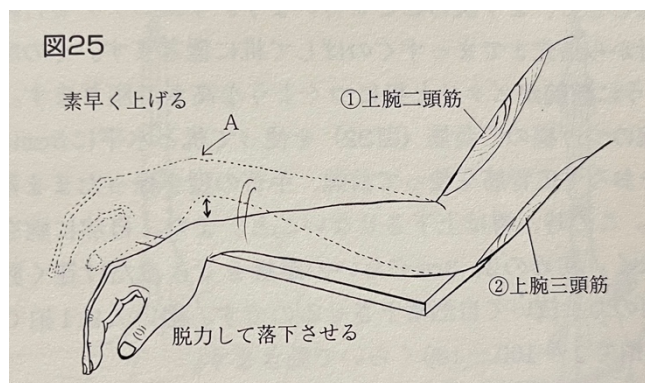
This time player should support the whole arms and hand by the MCP joint of the third finger and loosen the arm until it is without tension from shoulder to hand. This method can help students feel the arm's weight and the sense the support from the MCP joint of the finger. In order to make the students feel the weight better, Matthay improved Breithaupt's exercise. Matthay believed that when the arm is falling, the upper arm muscles need to control its falling speed so that the desired sounds can be obtained (Matthay, 1932). However, Matthay's upgraded version is difficult for beginners. Therefore, before using Breithaupt's exercise, it is better to learn to drop the arm with a controlled speed.

There are also some exercises for arm relaxation and coordination in modern piano pedagogies that adolescent beginners can refer to. Among them, the Japanese Mikimoto method and the Hungarian pianist Sándor's method are relatively representative. Mikimoto (2010) suggests late beginners should do the

following exercise: place your forearms on a desk and avoid using the muscles between your elbows and shoulders – the biceps – as much as possible; then raise your forearms as fast as possible to a height of 3-4 cm from the desk, and finally drop them and relax completely (see *Figure 5.9*). The exercise above can be repeatedly practised according to the different rhythm.

Figure 5.9

Mikimoto method for relaxing arms



Source: 御木本澄子 (2010) 『正しいピアノ奏法』 (第 16 刷発行) 音楽之友社.
P. 35.

This exercise can be taught to adolescent beginners before touching the piano so that the students can directly feel how upper arm relaxation works, and it is also useful to relax wrists. Furthermore, it lays a foundation for the subsequent lessons on the principle of leverage. This exercise can also help to practise forte in later piano learning. Sándor pointed out gravity as a source of energy for piano performance and emphasized the importance of the Breithaupt's arm-drop. Moreover, Sándor summarized the arm-drop technique of Matthay and

Breithaupt, and he added a rebound step to the last motion, making the full sequence as follows: raise – lower – rebound (Sándor, 1982). The final step, rebound, includes two actions. One is to fix your hands on the keys with fingers, which as Breithaupt said, involves keeping the wrists slightly depressed. The other is to return upward, and the upper arm needs to be prepared in advance.

These are all recommended methods for adolescent beginners to relax their arms. Relaxing arms is the second step in learning the piano and has been regarded as a critical point in many teaching methods in the past three centuries. The first step is to learn posture. Therefore, beginners should learn to relax arms before finger training, which will help coordinate the movements of various motor organs, to minimise the probability of injury, and ultimately achieve the purpose of learning and practising the piano efficiently.

After learning to relax the arm, the weight-touch and weight-transfer can be introduced into the teaching plan. I will not write too much detail about weight-touch because instructors and students can refer to Breithaupt's work – *Natural Piano Technique Vol. 2: School of Weight-Touch-Natural Piano Technic*. As for weight transfer, which is considered an essential technique in piano playing, it is an important technique in the Russian piano teaching system, and in Germany also. However, there is no obstacle to understanding the technique in a theoretical way. In contrast, in actual playing, it is not recommended to guide adolescent beginners in this method because students still cannot coordinate the body well,

and their sense of weight is still deficient. Therefore, when students do the arm-relaxing exercise, the wrist, elbow, and shoulder joints all play a critical role, and it is imperative to understand the features of these points. Furthermore, at the beginning of the piano lesson, introducing the principle of leverage within the body is also an essential part of understanding the body's coordination.

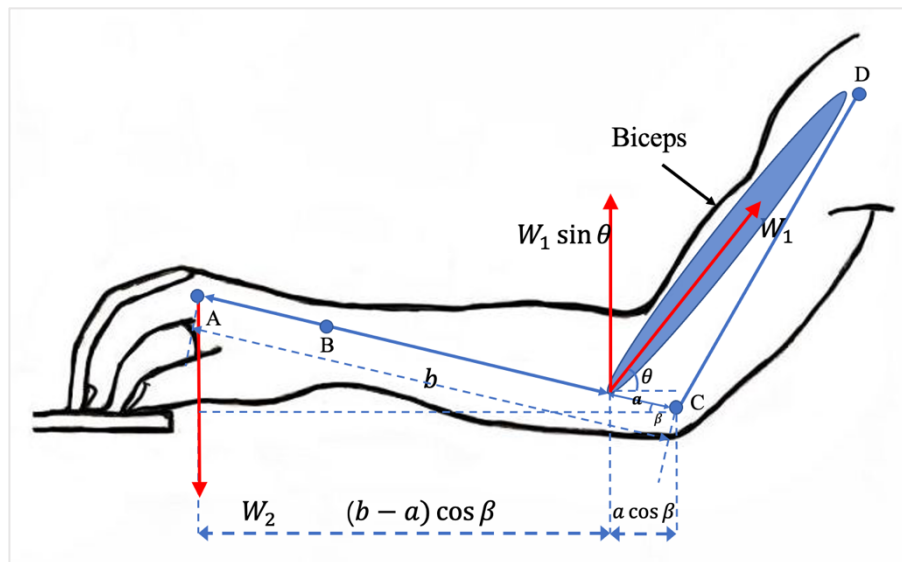
Kalkbrenner formally treats the body as a lever system in piano playing for the first time in the history of piano pedagogy (Kalkbrenner, 1830). However, the first time the mechanism of leverage was practically applied in piano performance was Ortmann, who created the biomechanics of piano technique. Ortmann's book which we mentioned in the last chapter, *The Physiological Mechanics of Piano Technique*, reveals seven mechanical principles: rigidity, plasticity, elasticity, compressibility, expansibility, gravity, and inertia. (Ortmann, 1929) These basic mechanical principles affect motions in our daily lives and play an essential internal and external role in piano performance, which Matthey noted in his book, *Visible and Invisible in Pianoforte technique*.

The following is a discussion and analysis of the arm lever. As shown in *Figure 5.10*, I made a mechanical analysis. The four points A, B, C, D are the MCP joints, wrist, elbow, and shoulder, and they are the fulcrums of the finger, hand, forearm, and upper arm respectively. From this point of view, there are four small levers. These levers are powered by the muscles that wrap around them and are moved by their tendons. The human arm is classified as the third class of

lever. Although the effort is always more significant than the load, the load can get a broader range. During piano playing, what the players need to know is that there are four parts as the base for those four fulcrums of A, B, C, and D. The base of the MCP joint is the hand, the base of the wrist is the forearm, the base of the elbow is the upper arm, and the base of the shoulder is the upper body. Recognising the relationship between these four parts will help adolescent beginners understand the principles of movement and the power source of each part better. Therefore, I made a mechanical analysis of the lever principle of the arm with the elbow as the fulcrum when playing the piano below.

Figure 5.10

Arm lever with the elbow as the fulcrum



*Made by the author

As shown in the figure above, W_1 represents the muscle tension of the biceps, W_2 represents the load on the forearm, a is the distance from the connection point

of the tendon and radius to the elbow joint, b is the distance from the centre of the load to the elbow joint, θ is the angle between the direction of muscle tension and the horizontal direction, β is the angle of the arm of force and horizontal direction. If the lever is balanced,

$$(W_1 \sin \theta - W_2) \times a \cos \beta = W_2 \times (b - a) \cos \beta$$

$$W_1 \sin \theta \times a \cos \beta = W_2 \times b \cos \beta$$

when the upper arm is in a vertical position to the forearm, $\theta = 90^\circ$, $\beta = 0^\circ$, therefore,

$$aW_1 = bW_2$$

In the formula, $W_1 \sin \theta - W_2$ represents the elbow joint reaction force. If $aW_1 > bW_2$, the forearm flexes at the elbow joint; if $aW_1 < bW_2$, the forearm extends at the elbow joint. On the other hand, in piano performance, it is impossible to keep the upper arm and forearm vertical all the time because the leverage is affected by the two angles θ and β . For an adolescent beginner, these four levers – finger, hand, forearm, and upper arm – should be used corporately. It should not be limited to one of the levers; their coordination is necessary. With the coordination of these levers, the muscles and tendons around them can also coordinate to achieve more efficient movement.

In addition, to ensure the independence of the keystrokes of the fingers, players should move within the range allowed by lever activities, and the other three levers should follow the lead of the fingers. That is to say after learning how to relax the arm, the purpose of finger training is to make the arm match the finger movement better. As Leschetizky realised,

*Through them the fingers finally acquire exquisite sensibility, and the wrist also soon learns to follow the movements of the fingers. The arm, to be sure, remains a clumsy fellow, always having to be guided lest he throw fingers and wrist off the track by faulty movements.*¹¹⁷

An exercise which I am using when I teach students, which for the fingers to guide the arm can be trained through the following steps: First, the instructor suggests the student stand at the lowest register of the keyboard and face toward the high register keyboard, and then use the second and third fingers of the left hand to start from the lowest note, like a human walking. Using the second finger as the right foot, and the third finger as the left foot, walk to the highest tone. During this process, the instructor should remind students to keep their arms relaxed, and actually, the MCP joints seem like the human body's waist. Next, in the same way, use the second and third fingers of the right hand to go from the highest tone to the lowest tone. Then, you can practise with the third and fourth

¹¹⁷ Brée, Malwine. (1902) *The Groundwork of the Leschetizky Method*. New York: G. Schirmer. p. 80.

fingers, and the fourth and fifth fingers in turn. However, since using the fourth and fifth fingers is more difficult, it is recommended for students to practise them “step by step, walking firmly on the ground”. Through the exercises, adolescent beginners can quickly understand how the fingers lead the three levers behind them, and it can help beginners to feel arm relaxation well.

There is a modern method which is also centrally concerned with the principle of leverage, Whiteside’s method, *Indispensable of Piano Playing*. It is based on Ortmann’s method, but Whiteside viewed the whole body’s levers. Besides the four levers mentioned by Ortmann, Whiteside added the fifth lever, the body, and its fulcrum is the hip (Whiteside, 1961). Therefore, we can find that Whiteside treated the whole body as a mechanical lever; she regards the body as the main lever and the arms as the force-arm of the lever. Thus, horizontal, vertical, and internal and external displacements can greatly enhance the coordinated function of the body’s motion organs. Furthermore, the fulcrums of the five levers – the finger, hand, forearm, upper arm, and upper body – are the knuckle, wrist, elbow, shoulders, and hips respectively (Whiteside, 1961). Adolescent beginners need to connect movements in daily life with piano performance to fully understand these five levers, and their movement principles and functions.

A specific course at Tokyo University of the Arts called Konnyaku Gymnastics can help relax the whole body, and it is being utilised to directly

understand the body lever principle. Here is a brief introduction to this method: First, place your feet shoulder-width apart and stand up straight, two arms hanging naturally by your two sides; then gradually bend forward with your waist (the fulcrum of the body lever) while keeping other body parts naturally relaxed; take the shoulder joint as the fulcrum, keep the body relaxed, and raise the upper arms to the horizontal position to form a line with upper limbs. You should only move the shoulder joints and keep forearm and hand relaxed. Next, take the two elbow joints as the fulcrum, keeping the body relaxed, and raise the forearm to the horizontal position and keep a line with upper arm. Also, you should keep hand and fingers relaxed. In the same way, take the wrists as the fulcrum, raise your palm – not fingers – keeping fingers lowered and relaxed. At last, take the MCP joints as the fulcrum and raise fingers to the line with arm and hand, keeping the body relaxed. When you finish the actions above, do the opposite actions in reverse order dropping down the fingers, palm, forearm, and upper arm in turn. During this process, you should not apply internal force from the body, instead only relying on gravity. Hence due to the gravity and inertia force, larger locomotive apparatuses such as the arms will swing acutely.

When practising Konnyaku Gymnastics, students should know the levers because it can help the student feel how the fulcrum of each lever of the upper body works. Therefore, the exercise is important for adolescent beginners to experience body movement after obtaining a theoretical understanding of the body levers. From the physiological perspective, these gymnastics can help

adolescent beginners feel the movement of each part of the upper limbs and the relaxed state of muscles. Furthermore, this exercise can help adolescent beginners feel the gravity and inertial force from the physical-mechanical perspective and provide a practical basis for learning weight-touch and weight-transfer in the following steps. Thereupon we can see the usefulness of Konnyaku Gymnastics, which is maybe why Tokyo University of the Arts offers it as a course.

At the end of the 19th century and the beginning of the 20th century, there was another theory about body coordination: muscular synergy proposed by Deppe, mentioned in Chapter IV. Muscle synergy, simply put, is the coordination between muscles. From a physiological perspective, it is through specific nerve stimulation, thus mobilizing the coordinated movements of muscle groups (Binder, Hirokawa, & Windhorst, 2009). Most of these muscle groups are composed of many small muscles. Muscle synergy is considered a simplified version of the body's movements output and input (Sabzevari, Jafari, & Boostani, 2017) to mobilise more muscles by the central nervous system with fewer commands (He & Mathieu, 2019).

There is a significant effect of physical coordination on piano performance, the sense of balance (equilibrioception) decreases with age (Rose & Jones, 1998). Also, it is a severe problem for adolescent beginners, which was already discussed in Chapter III. Therefore, I suggest that after adolescent beginners

learn posture, the relaxation of the arm and the coordination of locomotive organs should be taken as the next step. Additionally, the physical basis such as lever principle and physiological evidence such as muscle synergy should also be conveyed to the students to help them understand its principle and mechanism. Moreover, besides the exercises introduced above, students can also relax their arms and practise body coordination in daily life. For example, active video games can improve balance in both developing children and adolescents and can improve the motor skills of non-typically developing children (Page, Barrington, Edwards, & Barnett, 2017). One example is the game Nintendo Ring Fit Adventure, which has swept all over the world in recent years. Consequently, whether it is systematic or daily practice by other measures, piano learners should permanently attach importance to physical coordination and arm relaxation.

5.3 On Music

Music and language are not only similar in expression, but more importantly, music is similar to the inner beauty of language, such as artificial sounds, extending language from whole, which makes sound meaningful and coherent. (Adorno & Gillespie, 1993) However, I think music language has a very similar place in the language system. Like music theory, include harmony and texture are a kind of music writing system. The writing system, as the basis of language, there are three necessities: 1) language's limitations in time and space; 2) it is necessary for the development of human cognition; 3) it is necessary for cultural

inheritance. Due to writing system, the history of human civilization can be passed on, and technology and literature can continuously accrue development and progress. It is the same as the music writing system, there are three reasons: 1) the score breaks through the limitations of time and space; 2) the development of music theory reflects the progress of human cognition; 3) the evolution of music history is a part of human cultural heritage. Therefore, the writing system of music is very important for starting to learn music. Usually, as adolescents or adults, understanding its writing system is the primary task if they want to learn a new language. Similarly, music as a language, the first step to learning music should be from how to read music.

For adolescent beginners, after they obtain the correct scientific playing posture and body coordination skills, it is important to learn how to read music language. That is because adolescent beginners' comprehension and cognitive ability are higher than children, and they can take initiative in thinking. Score reading is considered a problem that should be prior solved among adolescent beginners by instructors, according to Chapter III. Therefore, instructors should guide students to study music at first, which can improve their ability of reading and understanding music. After they can read the music rapidly, the thing left is just to use the playing organs to express music. Bertini believes that the teaching system in the initial stage should focus on how to use fingers and other motor organs to play the piano, but this is wrong (Bertini, 1848). In Europe, many musicians can play not only one musical instrument but also others as well. One

of the reasons is that they can read music quickly and accurately, and musical instruments are only a means for them to express music. As one of the students who started learning piano in adolescence, I found that when I did not understand the music score yet, no matter how I practised with my fingers, I could not overcome the difficulties. However, after analysis and reading the score deeply under the guidance of my supervisor, I found I could solve the difficult parts. It is the result of reading music earnestly. Furthermore, from the investigation in Chapter III, we know that the adolescent beginners' pleasure in piano practice is in direct proportion to the piano practice time. Therefore, it further proves the importance of adolescent beginners learning music theory, because when they learn to understand the music, they can gain more pleasure in practising the piano and thus spend more time practising.

Regarding how to read music, there is a vocabulary and grammar in music language as well. The note is analogous to one of the 26 letters of the alphabet, and the vocabulary is made of the notes combined with various kinds of rhythms and note values; grammars is found in musical phrases and chord progressions; the conjunctions between these phrases are represented by harmony. Therefore, the precondition to know how to read music is to learn music theory, and this has been accepted by plenty of pedagogies and methods in the past three centuries.

Before starting finger exercises, instructors need to give three or four lessons on teaching adolescent beginners the basics of music theory. The first thing that

should be taught is music notes, pitches, and scales; these are the foundation for reading music. After students know the music notes well, it will speed up the subsequent learning (Richardson, 1859). Because the music note is a kind of letter symbol, score reading speed can be improved when you can recognise its meaning through unconditioned response. Moreover, if the student can familiarise the shape of notes groups, such as scale and arpeggio shapes, it will be the basis for rapid score reading.

Then, three core elements of music should be taught: rhythm, melody, and harmony. Among them, rhythm should be stressed for adolescent beginners because many technique problems come from rhythm. Although many students have been learning piano for many years, they still have problems in score reading and cannot get rid of the metronome, even mistakenly thinking that the metronome is the saviour in practice (Bertini, 1848). One of the reasons is that those students still cannot understand rhythm thoroughly, and their bodies and brains lack a sense of rhythm. Therefore, regarding rhythm, adolescent beginners should be clear about the following three aspects: 1) Students need to learn rhythm correctly. For example, the rhythm of the triple metre is often used in dance music, such as Bach's French Suite, English Suite, and Chopin's Waltzes. However, in terms of dance, their beats are not one, two, three, but one, two, three and two, two, three, a double metre actually. 2) According to the types of rhythm, practise with your body. Because rhythm is based on feeling, sentiment, and emotion, all derive from our inner sense of the body. When we are speaking,

we separate the sentences into different phrases according to their meaning with the breath, and this requires our organs such as mouth, nose, trachea, and lung co-ordinately working together. Moreover, piano playing requires players upper limbs and respiratory system to co-ordinately sense rhythm. This can help the player's body not be stiff but soft and flexible. In general, the body's internal environment and locomotive organs need to cooperate in perceiving rhythm. One more thing that needs to be emphasised is that rhythm is perceived with the body rather than count the rhythm by the physical motions of the body. As Abby Whiteside said, *feel the over-all rhythm of music in his body and find an emotional outlet in playing it from this center.*¹¹⁸ 3) The method to practise rhythm from Joan Last can be used for adolescent beginners because it seems like a mathematical game, arousing students' interest (Last, 1972).

When teaching this basic music theory, it can also be carried out with related finger exercises, but a prerequisite is that the student should be required to recognise music notes, staff, and pitch well. When leading students to study the staff, a scale diagram often appears at the beginning of the teaching materials. After students can rapidly identify the note names of the bass clef and the treble clef, the scale practice can be guided. Latour, Herz, Spencer, Bertini, and other 19th century pianists and teachers all thought it is better to study basic music

¹¹⁸ Abby Whiteside (1969) *Mastering the Chopin Etudes and Other Essays*. New York: C. Scribner's Sons. p. 161.

theory and practise fingers simultaneously, and they wrote short etudes illustrating various topics in music theory and marked the fingerings. After learning the treble clef notes, students can study how to play scales on the treble clef staff and indicate the fingering under the instructor's guidance; meanwhile, eyes should be on the notes instead of on the keys or fingers (Richardson, 1859). The nervous stimulation path, note – eye – brain – hand, significantly shortens the brain's reaction time. Hence, it can improve students' speed in score reading, and their sense of keyboard space can also be cultivated gradually.

In past methods, it was emphasised that the study of music theory should be introduced first, especially in the methods of the 19th century. Almost all the methods introduced the basic knowledge of music theory at the beginning. In the 20th century, lots of method books had accepted the importance of music theory. However, today, to help adolescent beginners achieve their goals as fast as possible, teachers seem to ignore or delay the study of music theory. In fact, this cannot improve their learning efficiency, but can cause many problems for those students. Because of their independent thinking ability, they easily get deeper and deeper into these problem swamps, resulting in wasting time and without solutions. Therefore, studying music theory at the beginning of piano learning can bring an anti-epidemic needle to students and lay a foundation for good sight-reading and score memorisation. When students get the resource of music theory, it will stimulate their score reading because the ability to recognise the musical phrases, harmony, and note types has been significantly developed. However,

reading scores only by using the eyes and brain are not enough. The role of the ear also can not be underestimated. Thereupon, solfeggio study and practice has been given a special priority in one of the methods of score reading.

Solfeggio is of great help in reading and even memorising music scores, and I had the actual experiences to perceive this point. Before entering music school, I had never received systematic solfeggio training; after entering the music school, I realized that I could not be sensitive to the timbre and tone quality I produced. As a result, many techniques could not be conquered for a while, and the more painful thing is that due to the lack of proficiency with music theory, I encountered many problems in reading music. And yet, after a period of study, although I became more proficient in applying music theory, the correctness and comprehensiveness of reading music had not greatly improved. Hence, I found the reason that is the lack of solfeggio training. As Combe¹¹⁹ said,

*The most helpful skill for help with true sight reading is sight singing, or solfege. Learning absolute pitch is one of the best ways to develop sight singing.*¹²⁰

¹¹⁹ Mademoiselle Yvonne Combe was a disciple of Debussy. She taught the two daughters of the author who wrote the book *Fundamentals of Piano Practice*. Combe founded Plainfield French School of Music in 1927, which cultivated lots of musicians.

¹²⁰ Chang, Chuan C. (2016) *Fundamentals of Piano Practice*. Florida: CreateSpace Independent Publishing Platform. p. 136.

Through solfeggio training, students can become more sensitive to the harmony in cadences, modulations, and other places. Furthermore, these places usually follow rules in music theory. Hence the fingers can complete it naturally, even reflexively. Nevertheless, Furuya (2012) compared with the students who had received music training before the age of seven, the late beginners who start music training after age nine have significantly fewer auditory nerve cells and it is difficult to improve their pitch accuracy and rhythmic sense in a short time. Additionally, even late beginners can develop good ears, but this ability will diminish over time; hence, it is necessary to stimulate the auditory nerve often. (p. 18; pp. 70-73) Therefore, to teach solfeggio to adolescent beginners, solfeggio teachers need to make a better strategy to adapt to the physiological conditions of those students. Finally, after completing the study of music theory and the training of basic solfeggio, the efficiency of music score reading will be improved.

The knowledge of music theory and the training of solfeggio facilitate rapid score reading. The difficulties in score reading have been discussed more or less in the above, but for adolescent beginners, the main problem is they cannot identify the score information rapidly, including the chord progression, phrases, and music texture. It shows the necessity of music theory studying. If the visual field is too narrow to read more contents of the music score, it can lead to discontinuity in the information that the brain obtains; additionally, the sense of rhythm can be disrupted. Finger skills also affect reading speed. These problems

exist side by side and bring the difficulties to adolescent beginners in score reading. Many instructors have unique views in dealing with these problems, and perhaps they have planned a series of solutions to score reading. However, there is no clear, scientific, and effective method for adolescent beginners. Therefore, having studied the methods and pedagogies of the past three centuries and combined them with the achievements of modern scientific research, I will give the following suggestions for score reading practice.

First, a large volume of reading training is indispensable. Students can practise with basic level works first. They should practise reading a piece from beginning to end without stopping, even if wrong notes or chords occur. After practising the same piece several times in this way, students can change to a new piece for practise; also, they should have a rhythm conception in mind during practice (Plaidy, 1852). In addition, it is suggested that the teacher plays together with the student in a higher octave above the student's register (Deutsch, 1950). This method can motivate the students and encourage them to continue moving their visual field on the score. Moreover, after much practice, the ability to read scores will be improved. At this time, students should begin learning to analyse harmony.

Secondly, Furuya shows six factors contribute to an advanced ability to read scores: 1) A lot of score reading practice has been done up to the age of 15; 2) Both hands can be used equally; 3) Information contained in the score can be

processed quickly; 4) The pitch and tone can be imagined correctly; 5) There is a strong working memory, the shapes of note groups and chords can be remembered, and there is a good sense of rhythm; 6) A proper fingering can be decided quickly. (Furuya, 2012) These six factors can serve as six keys to score reading. Fundamentally speaking, they are based on music theory and solfeggio training and require finger skill. During teaching, we often use this metaphor: Ten fingers are a symphony orchestra, and the brain is the conductor. The music score is seen by the conductor's eyes prior to the part being played by the orchestra, and this is also the same principle in score reading. Consequently, the most radical thing is that the eyes must see the notes, rhythm, harmony, and shapes.

Finally, when the ability to read scores is improved, the students can also gain six other benefits: 1) enjoy music; 2) cultivate patience; 3) improve the enthusiasm for practising the piano; 4) cultivate the ability of self-study; 5) consolidate knowledge of music theory; 6) be fond of music much more (Newman, 1956). Some problems reflected in the questionnaire survey of Chapter III, such as lack of habit of autonomous learning, short practice time, and so forth can be solved by score reading practice.

According to the four dimensions of music theory, rhythm, solfeggio and score reading, this part expounds on adolescent beginners' problems and difficulties in piano learning. Most of these problems need to be solved at the

beginning of piano learning, except the score reading, which needs to be gradually solved based on improving playing skills and will take more time than others. Then, musical comprehension can be developed using different methods mentioned above and through long-time practice, which will help reading speed improve. Thereupon, after the study of posture, the practice of arm relaxation and body coordination, and the fundamental study in music, finally, the fingers can start systematic training on the keys.

5.4 On Techniques

What are the differences between technique and mechanics? For adolescent beginners, this question needs to be clarified before beginning systematic finger training. Mechanics is a kind of physics that explains how forces work on objects and physical motions, while techniques are a practical experience, method, and ability to deal with specific fields such as science. Put another way, technique is playing the piano by using fingers and the brain. For instance, when practising Hanon's finger exercise, *The Virtuoso Pianist in 60 Exercises*, many students blindly practice finger keystroke, and they think it can improve finger energy and flexibility. Indeed, it can achieve their purposes to a certain extent, but it is not helpful for timbre and musicality after a long time of practice. However, if students pay attention to the following points, it will make the practice more efficient and exciting: focus on the acoustics, music and resonance.

About the questionnaire survey results in Chapter III, there are some difficulties confusing adolescent beginners, and the most significant problems in need of a solution are the following three: scales, arpeggios, and using the 3rd, 4th, and 5th finger. Here I will compare the differences between adolescent beginners and children to give scientific and effective practice suggestions and help teachers guide adolescent beginners with a better strategy. Moreover, the three problems are the basis of finger practice for both late and early beginners. Furthermore, flexibly using the 3rd, 4th, and 5th fingers are vital for cultivating finger function, balance and obtaining the skill to execute complex performance skills. The other techniques include several difficulties commonly felt among adolescent beginners – tone colour, dynamic control, and fast finger movement – which will be discussed in combination with the physiological characteristics of the adolescent students and the physical properties of the sound. Then I will provide a set of modern reference bases for instructors and adolescent students.

5.4.1 Scales

Scales and arpeggios are a chasm that must be surmounted in piano learning, Bagatelle music as short as one to three pages, and sonatas and concertos as large as tens or hundreds of pages all contain short or long scales and arpeggios. Perhaps, to put it another way, the basic structure of musical phrases is composed of these long and short, intermittent scales and arpeggios. In terms of playing techniques, the scale and arpeggio are the primary means to inspect the

coordination of playing apparatuses because their practice requires not only the fingers, but also the assistance of wrists, arms, and shoulders. Moreover, the body also needs to move left and right with the hip as the fulcrum in a horizontal movement. It is a whole set of physical exercises. Therefore, adolescent beginners must practise scales and arpeggios only after acquiring the natural postures, coordination, and relaxation skills.

With the development of the piano since the 18th century, the keyboard's register has become wider, and the musical expression has become richer and more colourful; thus, the scale and arpeggio are more and more applied in piano music. Therefore, more and more methods mentioned ways to practise scales and arpeggios. I will choose the methods from the past three centuries that adolescents can use and talk about scales first, and arpeggios will be discussed in the next section.

From the development of pedagogical approaches to scales over the past three centuries we can see that methods have shifted from an emphasis on music theory to human-oriented natural movement. At the beginning of the 19th century, classical music reached its peak, and it included countless scale segments in music. In order to play these scales well, a variety of practice methods and pedagogies were born, but all of them were based on music theory. They usually taught students something along these lines: Before putting hands upon the keys, the students need to write the scales of each major and minor on the draft paper

with the names of notes (C-D-E-F-G-A-B), and then write down the corresponding sharp and flat marks next to the notes that need to change (Hummel, 1828). On the one hand, this method can help students become familiar with the signatures and lead them to theoretically, deeply understand and memorise the relationship, function, and rules of twenty-four major and minor scales. Additionally, it can help students train a pair of “correct ears”. However, although this method is complicated and tedious for early beginners whose understanding and cognitive ability is not mature, it is perhaps available for late beginners.

Furthermore, when students start to learn scales, instructors should start with C major and A minor as a model *to render the pupil familiar with, and certain as to the succession in the 24 diatonic scales,*¹²¹ which suggests that practising scales should be according to the C-G-D-A-E order first, then other scales should be practised in terms of increasing sharp and flat marks. Theoretically speaking, this is the most straightforward introduction, but it is difficult to play C major and A minor scales using a natural human hand because fingers’ lengths are different, the 2nd, 3rd and 4th fingers are longer than others. Therefore, when playing the C major or A minor, these three fingers’ fingertips position should be adjusted in terms of the other two. Compared with the relaxed hand bridge on

¹²¹ Hummel, Johann Nepomuk. (1828) *A Complete Theoretical and Practical Course of Instruction on the Art of Playing the Piano Forte*. London: Boosey & Co. p. 54.

the keys, the hand bridge at this moment needs to be controlled; therefore, it does not conform to the naturally relaxed structure of the hands. As a result of that, for adolescent beginners, I do not recommend using C major and A minor as the model for studying scales. Instead, students should take B major and g[#] minor as a model. Because the longest three fingers are naturally placed on the black keys, the black keys' height offsets the different lengths between the fingers. This is more in line with the natural physiological structure of the hand bridge.

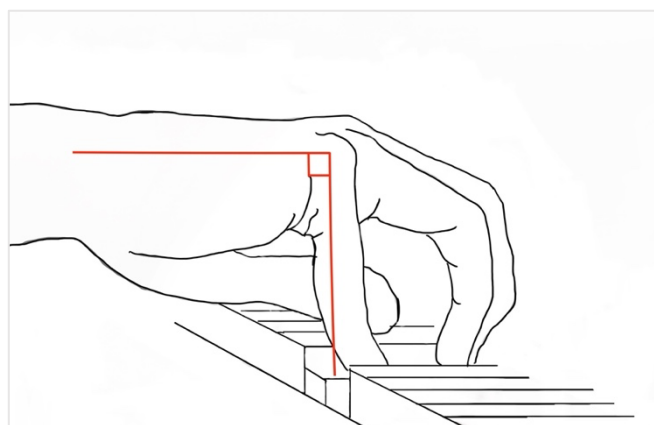
Before practising scales, most methods believe that five-finger training is necessary. Keystroke practice is the first step for practising all playing techniques, just like human beings have to learn to walk before jumping and running. Regarding the keystroke, the hand bridge is the basic structure, which has been discussed above. For keystroke technique I will refer to the Spencer and Hughes's method discussed in Chapter IV. Teachers can lead students to practise another keystroke exercise: Imagine fingers as two legs and the MCP joints as the waist. Then, place an eraser on the hand bridge (opisthenar) and strike keys by using each finger from the thumb to little finger, using the method described by Spencer and Hughes. During the exercise, keep the eraser on the hand bridge, sit the body straight, and let wrists, arms and shoulders relax.¹²² Although the length of each finger is different it is necessary not to allow the plane of the back of the hand to have an excessive inclination to ensure that the eraser does not fall. Therefore,

¹²² This exercise comes from Professor Miho Shibata, the author's piano supervisor.

when approaching the ring finger and little finger, turn the wrist outward gradually at first, and then strike the key with a straight little finger almost vertical to the key; in other words, there is almost a right angle at the MCP joint between the little finger and the back of the hand (see *Figure 5.11*). However, because of individual differences, the angle could be bigger or smaller. If there is no significant difference in the length of the little finger, ring finger, and middle finger, the angle is much larger than a right angle. It could also be close to a right angle, but in any case, it will not be smaller than the right angle. Additionally, because of the coordinated function of the hand, when the little finger tries to make the angle, the forearm has to extend forward slightly to supplement the length of the little finger. Therefore, the students should notice this physiological feature.

Figure 5.11

Five-finger exercise hand position



*Made by the author

The 19th-century methods are the most systematic and detailed in the practice of scales. These methods include the following contents: Do the preparatory exercise first, practise with hands separately and then together, play scales with parallel motion and then in contrary motion, vary the tempo from slow to fast, and finally practice scales with different dynamics. However, in scale playing, the most difficult skills are passing the thumb under fingers and the fingers over the thumb smoothly, and the former is very complicated. Concerning practice strategies for thumb crossing, Richardson, Plaidy, Pauer, and Leschetizky suggested preparatory exercises that isolate the motion of passing the thumb under the fingers and the fingers over the thumbs. They all wrote such exercises for students, like the following examples:

Example 5.3 Richardson’s finger crossing exercise¹²³



¹²³ Richardson, Nathan. (1859) *New Method for the Piano-forte*. Boston: Oliver Ditson & Company. p. 43.

Example 5.4 Plaidy's finger crossing exercise¹²⁴



Example 5.5 Pauer's finger crossing exercise¹²⁵



Example 5.6 Leschetizky's finger crossing exercise¹²⁶



¹²⁴ Plaidy, Louis. (1852) *Technische Studien für das Pianoforte spiel*. Leipzig: Breitkopf & Härtel. p. 26.

¹²⁵ Pauer, Ernst. (1877) *The Art of Pianoforte Playing*. London: Novello, Ewer & Company. p. 15

¹²⁶ Brée, Malwine. (1902) *The Groundwork of the Leschetizky Method*. New York: G. Schirmer. p. 23, 24.

The image displays a musical score for a triad exercise in the first inversion. It is divided into two parts: Right Hand (R.H.) and Left Hand (L.H.).

R.H. Part: The first staff shows a treble clef with a key signature of one flat (B-flat) and a 4/4 time signature. The notes are G3, B3, and D4. The second staff continues the exercise with various rhythmic patterns and fingerings (1, 2, 3, 4) indicated above the notes.

L.H. Part: The first staff shows a bass clef with the same key signature and time signature. The notes are B2, D3, and F3. The second staff continues the exercise with various rhythmic patterns and fingerings (1, 2, 3, 4) indicated above the notes.

Below the R.H. part, the text reads: "Triad-exercise in the first inversion."

It can be seen that in the methods of Richardson and Pauer, the fingering is indicated using the traditional Anglo-American system. The thumb is not the 1st finger, but the index finger is the 1st finger. This is a traditional fingering system inherited from the period before the Bach. It might make one more aware of the particularities of thumb, which may have some enlightenment for adolescent beginners.

According to modern research, these practices are based on the rotation and extension of the wrist, forearm, and shoulder. If without rotations and extensions, the scale playing will be difficult. When passing the thumb under the 3rd or 4th finger, with the 3rd or 4th fingers as the fulcrum, the thumb naturally passes through the hand bridge formed by the fulcrum, gliding along like a car passing through a tunnel. Of course, by analogy, the tunnel remains still while only the car is moving. The downward movement of the thumb reflects its unique physiological characteristics because its lateral movement range is broader than

that of other fingers. Also, it should be noted that the movement of the thumb depends on its third joint, the CMC joint (see *Figure 2.1*). Additionally, when the thumb passes under other fingers, it should quickly reach the destination key and then use the third joint of the thumb (CMC) to strike the key vertically. However, these preparatory exercises mentioned above are all based on C major as the model. When we put hands on the piano and form the hand bridge, the position of B major is the most suitable for this physiological feature because of the relationship between the length of fingers. When practising with B major, the displacement between the thumb and the key will be shortened because the third finger as the fulcrum is naturally placed on the black keys and the included angle between the thumb tip and the key plane is relatively small. Therefore, adolescent beginners can practise the exercises above in B major as well. For example:

Example 5.7 The thumb exercise in the right hand



*Made by the author

After completing the preparatory exercises above, the student can start scale practice. The scale practice methods in the 19th century mentioned above are available for adolescent beginners, and their playing manners should be understood at first, then the physiological methods of the 20th century can be

guided. Scale practice in the 20th century has been improved by integrating the theories of the 19th century with new scientific insights. First, Breithaupt's methods revealed that the scale practice should not start in C major. Passing the thumb under the fingers and fingers over the thumb should be executed by rotation of the longitudinal axis of the forearm (Breithaupt, 1909), and this idea influenced scale practice in the 20th century. To study scales, the student should start in B and D^b, F[#] and G^b, then A^b and E^b, E and A, and finally are the others (Breithaupt, 1909), since these scales are most suitable for the physiological structure of human hands and the rotation techniques. Moreover, the preparatory exercises for scales in the 20th century have been improved by combining rotation skills, as shown in the example below:

Example 5.8 Right hand preparatory exercise in B major



*Made by the author

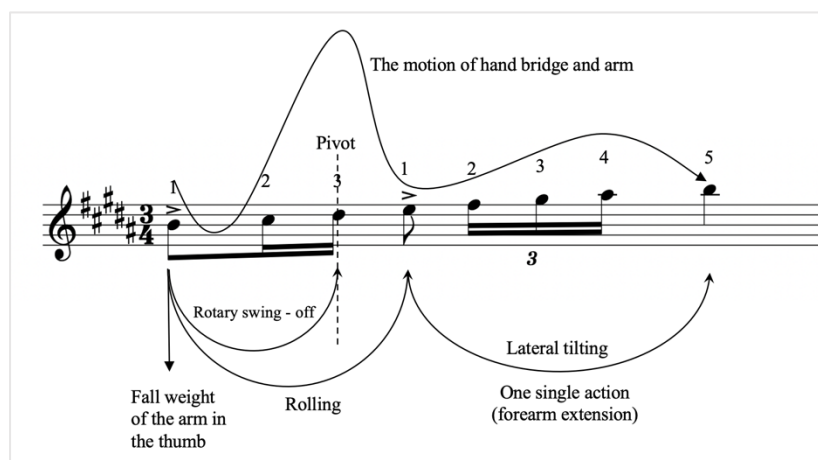
Rotation should be added to the preparatory exercise, and students have to use it freely in scale playing. As can be seen from Example 5.8, the arrow down means rotation towards the thumb (radius side, inward), the arrow up means rotation towards the little finger (ulna side, outward) (Matthay, 1932). Similarly, inward and outward rotation can be practised with Example 5.8. In addition, there

is also a new understanding of thumb usage. The physiological mechanism of passing the thumb under the fingers is flexion and extension on the lateral level of the CMC joint. After passing the thumb should strike the key vertically by the CMC joint and at this time the motion of the thumb is unnatural. One more thing that should be noted is that while the thumb passes under the fingers, the weight transfer will lose some quantity of weight (Ortmann, 1929), and the reaction of the keys is opposite to the movement of the arm (Gát, 1968). Hence, students should pay attention to keep the weight on the hand bridge, and the direction of the thumb's keystroke should be opposite to the direction of the hand motion to avoid an unbalanced and unsmooth keystroke.

There are two techniques, lateral shifting and weight touch, which can be applied to scale practice. They are based on the 19th-century method and can bring a qualitative improvement for adolescent beginners (Breithaupt, 1909). I summarised this specific method and combined with hand movements, then got the following figure.

Figure 5.12

the hand movements with scale exercise within an octave in B major



*Made by the author

In *Figure 5.12*, we can see that the movement consists of rolling and lateral tilting when playing the scale. Students should put the arm's weight on the thumb at first; then play C# and D# with the rotary arm and swing off the key at the end. In other words, it means releasing weight when playing D# with the 3rd finger. Meanwhile, the weight should be put on the 3rd fingers (its MCP joint), which is the same as the arm drop exercise with the 3rd finger; then with the 3rd finger as a pivot, pass the thumb under the hand bridge by a lateral motion; finally, play the notes like a five-finger exercise, from E to B, moving the wrist outward gradually and changing the angle of MCP joint of the 5th finger to keep the plane of hand bridge flat, also simultaneously drawing the forearm inward slightly. Moreover, the rotary action of the elbow is necessary because of coordinated function, and it is better to keep the wrist outward to avoid muscle tension in the little finger (See Breithaupt's wrist posture section in Chapter IV). Furthermore,

it is necessary to be careful about the horizontal displacement of finger movement when crossing the thumb to avoid striking the wrong note. This requires a correct posture and position of the body and hand, the sense of space, and the coordinated rotation of the wrist and arm. The vertical movement also should be noticed. As shown in *Figure 5.12*, the hand bridge and arm are at the highest point when playing D[#] with the 3rd finger as a pivot. After passing the thumb under the fingers, put the weight on the thumb (its CMC joint); then, because of the weight transfer, the hand bridge will move a little upward until A[#], and the forearm moves somewhat upward due to its extension; finally, when playing the B, the weight falls on the MCP joint of the 5th finger, and the 5th finger supports the hand with a close right angle in the MCP joint. Additionally, one should be careful of the inward and outward distance. The instructors need to consider the position between white and black keys, the player's finger length, and their hands' size to find the most suitable position for the keystroke.

So far, besides traditional scale practice, I have supplemented some methods for practising scales through several more scientific points and ideas. Moreover, I would like to give some more new suggestions for adolescent beginners to practice scales: 1) Adolescent beginners have more or less acquired music education no matter whether they are in school or off-campus; therefore, while practising scales, the musicality can be guided simultaneously so that the practice can be less frustrating. Also, adolescent beginners can deal with finger technique problems more easily by understanding music. For example, in the Hanon, which

everyone has practised, there are 24 major and minor scale exercises (it is recommended to practice B major first), and each of the exercises is in duple metre, as shown in *Figure 5.13*,

Figure 5.13

B major scale's resonance



*Made by the author

The duple metre gives an advantage to students because each bar is an octave, with four octaves ascending and descending, and the beginning of each octave is on the first beat. Thus, students can imagine each bar as a musical instrument or character to establish a thematic interpretation. At the end of the scale, students can sense the harmonic cadence and associate it with the hand movement, shown by the black arrow line in the figure. This develops students' hands coordination

and helps the brain quickly identify cadences in future studies, which is helpful for analysing music. 2) In *Figure 5.13*, the red wave line and coordinate axis tell us the piano's resonance effect by the acoustic frequency of the scale. Inharmonicity is richer in the bass and treble but minimal in the middle section. That is because the strings in the bass are thicker and longer than other strings in a grand piano, and the piano's shape increases the inharmonicity coefficient; in the treble, the inharmonicity coefficient increases because the strings get shorter but with high tension (Burred, 2009). Therefore, the peaks of the red wave line in the figure are at the treble and bass, which means that the resonance in these two places is the largest. Hence students need to express the sound's peak with the piano's acoustics, which can achieve a "three-dimensional" musical effect.

This part integrated the methods of scale practice from the 19th and 20th centuries and based on the physiological characteristics of adolescent beginners put forward several scientific strategies. Moreover, it includes some ideas from the 21st century. According to the maturity of bones and muscles in adolescents, these strategies can provide a more reasonable and scientific theoretical basis for adolescent beginners to practise scales, especially when it comes to using fingers and arms, and wrist rotation. Scales and arpeggios are usually a set of exercises. Thus, the next part will discuss the methods of arpeggio practice according to a contemporary perspective of adolescent beginners' characteristics.

5.4.2 Arpeggios

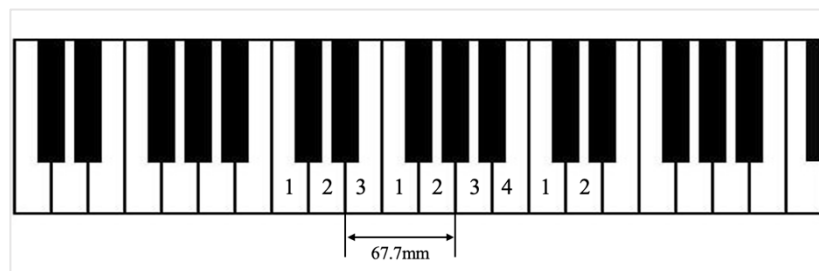
Like scales, arpeggios are also ubiquitous in piano music. However, when adolescent beginners start to practise arpeggios, they often cannot play them smoothly and freely, and their fingers cannot come to the correct keys accurately; meanwhile, their playing is without vitality and continuity. Moreover, their playing is usually done either with exaggerated arm movements or only the fingers working. The reason for these problems is that the adolescent beginners have not obtained coordination and relaxation of their playing apparatus, and they do not yet understand arpeggios well. Therefore, for them, the first step is correctly knowing what an arpeggio is. Though to a certain extent, playing arpeggios is like playing scale, as both involve passing the thumb under the fingers and the fingers over the thumb, horizontal movement, arm rotation, and weight transfer. However, there are several significant differences in arpeggio playing, mainly in the following aspects:

The first is keyboard distance. When playing scales and arpeggios, as we all know, whether ascending or descending, the displacement of fingers is different, and this displacement has a great deal to do with the length of fingers and the coordination of wrist and arm. The figures below revealed the displacement of the thumb, the third finger, and fourth finger when playing scales and arpeggios. For easy observation, I took scales and arpeggios in C major of the right hand as examples, and the fingering is indicated on the white keys. In this research, the

distance of the key is based on the Steinway piano; the width of each white key is around 22.5mm ($\pm 0.5\text{mm}$) and each black key around 9.5mm, and the gap between the two white keys is about 0.1mm. Moreover, for the simplified calculation, the unit for measuring fingers' displacement is a complete key width.

Figure 5.14

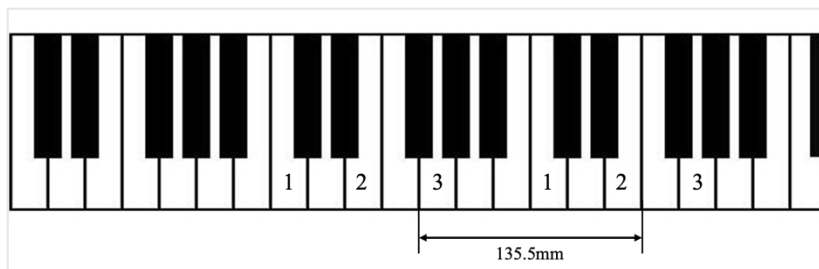
Ascending scale in C major by the right hand



*Made by the author

Figure 5.15

Ascending arpeggio in C major by the right hand



*Made by the author

The figures reveal the finger displacement in scale and arpeggio playing. When playing the arpeggio, the finger displacement is twice as far horizontally as in the scale. Moreover, the displacement of the thumb passing under the fingers is longer in arpeggio playing. Thus, as the pivot, the extension and flexion of the

third finger should be adjusted to adapt to the impact of the displacement change naturally. This is the second different point in arpeggio performance. However, it is not enough to rely on pivot alone to pass the thumb under other fingers because it requires a longer displacement. Therefore, players need to supplement the longer displacement by shifting arms laterally, and it is the third different point in arpeggio playing. Furthermore, the arpeggio needs more hand movements, including forward, backward, and vertical movements, to ensure weight transfers smoothly. Knowing these three differences between arpeggio and scale playing will help students to practice arpeggios more productively.

One preparatory exercise for arpeggios has been recognised by pedagogues over the past three centuries, which is to practise chords first. Chord practice is used to determine the correct fingering and form the hand shape in each chord position. It is recommended that adolescent beginners learn to play the common chords in all keys (Richardson, 1859), and while practising them, the hand should be a little extended and the fingers should move smoothly from one group to the next (Plaidy, 1852). The exercise is shown as follows:

Example 5.9 The exercise for fingers to move smoothly¹²⁷



This exercise will be helpful for adolescent beginners whose hands can reach an octave to learn arpeggio playing. In practice, pay attention to the centre of gravity from one note to another, and use the shoulder to drive the arm to do a slight rotation (Gát, 1968). Weight transfer in arpeggio playing is different from scales because the weight will be lost during playing. So, this exercise will also help adolescent beginners practise weight transfer. One more similar preparatory exercise that can be used for adolescent beginners is the method of Leschetizky.

¹²⁷ Plaidy, Louis. (1852) *Technische Studien für das Pianoforte spiel*. Leipzig: Breitkopf & Härtel. p. 41.

Example 5.10 The preparatory exercise for arpeggios of Leschetizky¹²⁸



He suggests playing the first three notes of the chord first (played like the five-finger training in the scale preparatory exercise), and then playing the last note with the fifth finger with inertia produced by turning the hand towards the fifth finger rapidly. Next the hand returns to the normal position to prepare the next arpeggio (Brée, 1902). Moreover, after playing the broken chord, students should be careful of the horizontal movement of the hand and the arm when they are preparing to play the next arpeggio. At this time, take the fifth finger as the fulcrum to gently flick the whole hand away from the key; the thumb uses flexion and extends horizontally like a leader pulling the hand towards the next chord position. Then, shape the hand and change the fingering to match the position of the next chord when fingers leave the keyboard. Finally, putting the weight of the hand and arm on the thumb (CMC joint) and taking the thumb as the fulcrum, let the hand fall back to the keyboard.

¹²⁸ Brée, Malwine. (1902) *The Groundwork of the Leschetizky Method*. New York: G. Schirmer. p. 48.

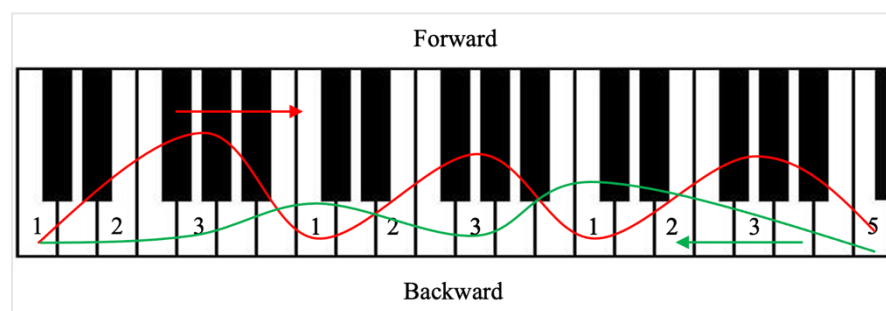
The preparatory exercises above not only need MCP joints to support the hand firmly but also hand-wrist-arm coordination. The order to practise arpeggios should be from B major, E major, G^b major, D^b major, and the last one is C major (Breithaupt, 1909), because of the natural shape of the hand. In the preparatory exercise, when the hand moves to the next chord, it will produce horizontal displacement, not only of the fingers but also of the hand, wrist, and arm. Therefore, to ensure the minimum work of the horizontal displacement, the fingers cannot be bent and cannot be completely straight. It should go according to the length of the fingers, especially the thumb, and we can regard it as a ruler (the CMC joint of the thumb) to measure the distance between the keys. The most vital finger movement is the thumb passing under the fingers and fingers over the thumb when moving horizontally. When the thumb passes under the fingers, the thumb should be extended and placed under the hand bridge and should prepare to strike the key with a certain angle (not a vertical strike). It should be played with continuity (Plaidy, 1852), because the thumb usually leaves the note before the next finger strikes the key (Philipp, 1908). This should be pointed out in case the students wrongly think that in order to play legato, they have to disrupt the coordination of the hand and arm in the horizontal plane.

Besides horizontal displacement, there is also a need for vertical and forward displacement. This is mentioned in the last part of the section on five-finger training. As the fingers walk on the keys like feet, they tend to move forward. Moreover, the MCP joint of the fingers will pull the wrist-arm forward, which is

also the result of the weight transfer on the hand. Whereas arpeggios are different from scales, the forward movement in an arpeggio is more intense to offset the longer playing displacement. Importantly, it should be emphasised that forward and vertical movements have a significant amplitude in arpeggios with fewer key signatures such as C major and F major. In arpeggios that have more key signatures like B major, the amplitude is relatively small. The principle of vertical movement is the same as that of scales, but the vertical displacement increases with the key distance. *Figure 5.16* and *Figure 5.17* show the trajectory of forward and vertical movements. Take the C major as an example here because its moving trajectory is the most noticeable one. The Red line shows ascending arpeggio, and the green line shows descending.

Figure 5.16

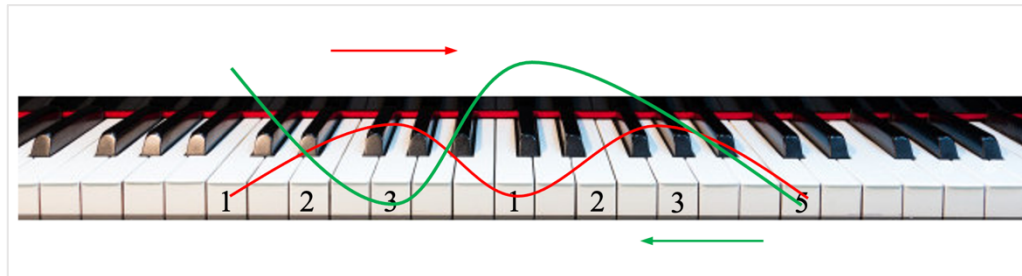
The forwards movement of the right hand when playing ascending and descending arpeggios



*Made by the author

Figure 5.17

The vertical movement of the right hand when playing ascending and descending arpeggios



*Made by the author

As can be seen from the figures, no matter the forward or vertical movement, the movement amplitude of the ascending arpeggio is relatively significant while that of the descending arpeggio is relatively gentle. In the ascending arpeggio, the thumb is too short to reach the note without an assisting motion. Therefore, the forward extension of the wrist and the arm are indispensable to supplement the insufficient length and help the thumb reach the position. However, in descending arpeggio, we can utilise inertial force to supplement the insufficient lengths when passing the finger over the thumb. Moreover, the third and fourth fingers are longer than the thumb. Hence, compared to the motion that passes the thumb under the other fingers, the amplitude of passing the finger over the thumb's motion is relatively gentle. In total, all movements in the horizontal (forward and backwards) and vertical planes include arm shift and rotation, and they serve to assist thumb action.

At the end of this part, some points need to be supplemented. When passing the thumb under the fingers in ascending arpeggios, the forearm also helps to supplement the insufficient length. The third finger is the axis, and the fingertips as the fulcrum to support the entire hand and arm. Currently, use the weight touch. The thumb moves horizontally with the forearm rotation, and now when the third finger releases the key, strike the next key from the slope. At this time, the direction of the keystroke is not vertical, and there is a certain angle between the thumb tip and key plane. But in the descending arpeggio, the thumb keystroke is close to vertical. No matter how the finger passes over the thumb or the thumb pass under the finger, the thumb should be prepared in advance, and should sustain the proper note value (though not legato) until the next strike. The rapid motion of the thumb is helped by the forearm's fast shift, to ensure the effectiveness of weight transfer (Ortmann, 1929). Therefore, it is impossible to keep the hand motionless in arpeggio playing. If the hand is immobile and only the fingers move, it will destroy freedom and speed, and is unscientific in terms of physiological principles. In addition, to ensure the effectiveness of weight transfer, the fingers should not be raised too high as well (Breithaupt, 1909).

5.4.3 Finger Independence

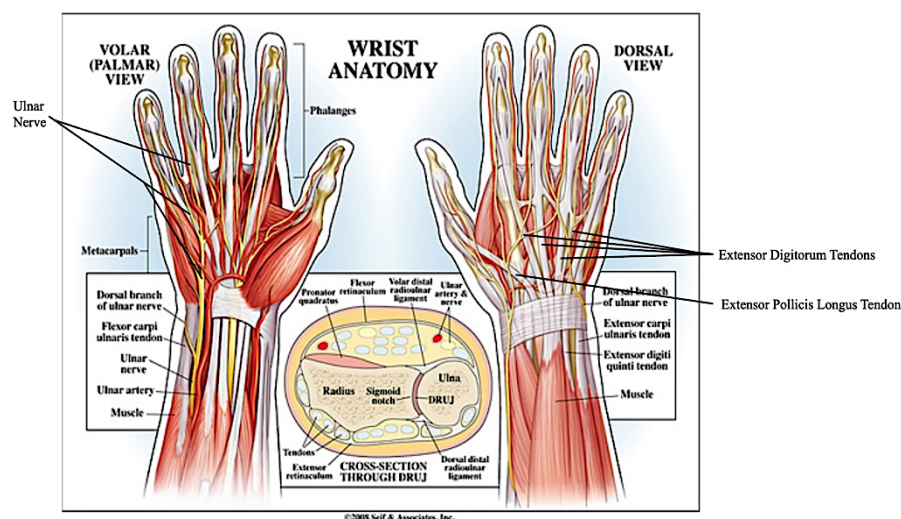
Based on the questionnaire results in Chapter III, finger independence is a widespread problem among early and late beginners. They think that using the 3rd, 4th, and 5th fingers is difficult. In this part, I will provide a scientific

theoretical basis and methods for helping them solve the problem. However, to solve the problem, the first thing they should learn is to cooperate fingers, wrists, and arms. Next, they must learn to relax the body and read the music, and to solve technique problems by thinking musically. Finally, it is necessary to abandon the antiquated idea that fingers must be trained like a fast-moving machine.

Finger independence exercise has been perplexing for piano beginners for a long time, especially among late beginners. However, due to changes in physiological conditions, the finger independence practice seems to be more challenging for late beginners. In Chapter II, I reviewed the physiological characteristics of adolescent hands. Here, I added one more physiological structure figure about the tendons and nerves of the hand and wrist because they are the most critical factors affecting finger independence. *Figure 5.18* takes the mature right hand as an example.

Figure 5.18

The tendon and nerves of the right hand and wrist



Source: HandSport Surgery Institute. Re: Wrist Anatomy. Retrieved from <https://handsurgeonsnyc.com/patient-education/wrist-anatomy/> (Accessed on Jun 18, 2021)

First of all, according to the figure above, we can see that tendons lead from the finger to the arm and connect with the arm muscles. Secondly, the extensor digitorum tendons of the second, third, and fourth fingers are connected side by side at the wrist. However, an independent tendon, the extensor indicis tendon, connects with the second finger independently. Unfortunately, the third and fourth fingers are without independent tendons, and both are without independent flexors and extensors. Therefore, their movements are influenced by each other. Additionally, the first and fifth fingers each have an independent tendon. Thirdly, because the innervation of the fourth and fifth fingers is done by the ulnar nerve, even if the tendon of the fifth finger is independent, its movement will be affected by the fourth finger.

Consequently, the fingers fall into two patterns: the first and fifth finger as one pattern, and the second, third, and fourth fingers as another pattern. Because there is an independent tendon connecting the second finger, its movement can escape from the restraint of the third and fourth finger. Moreover, because the fourth and the fifth fingers share the same nerve, their movements will affect each other. More importantly, all tendons are connected to the muscles of the arm, so the movement of the fingers cannot be ever independent of the arm, which means the arm essentially provides the fingers' energy. Thus, students and instructors should practise finger independence in terms of scientific evidence rather than blindly by mechanical finger exercise.

In addition to physiological effects, other factors also affect the ability of fingers to move independently. Age is the first factor. A study has shown that strength and finger coordination change with age, and this change generally exists in the neuromuscular apparatus (Latash, Shim, Shinohara, & Zatsiorsky, 2006). This leads to the decline of the primary motor ability of the index finger with increasing age (Beek, et al., 2019). Two more factors mechanical coupling and neuromuscular control influence on the finger independence. Mechanical coupling mainly limits the independent ability of the second, third, and fourth fingers; neuromuscular control limits the fourth and fifth fingers (Lang & Schieber, 2004). Moreover, callosal function is related to the improvement of hand independence (Gärtner, et al., 2013). Whether the affective factors are age or other physiological mechanisms, for adolescent beginners, before practising

finger independence, teachers should help students understand the physiological factors to prevent them from falling into confusion when practising the piano, blindly thinking that five fingers should be trained to move independently, thus causing finger injury. Teachers should also be aware the best practices for improving finger independence practice as well as the characteristics of adolescence (see Chapter II), thereby formulating effective pedagogies and methods for adolescent beginners.

Concerning the practice methods for finger independence, I briefly reviewed the methods of the past three centuries at first in order to find out whether there are any insights for adolescent students. Then, in consideration of the physiological characteristics of the hand mentioned above, a theoretical practice method will be put forward for adolescent students. Chapter IV mentioned the training apparatuses used for finger exercises in the 19th century, but their design and utilisation mostly violate basic physiological and physical principles, the result is injury to the users' fingers and hands. However, the training and exercises provided in the following are based on modern scientific research, their safety and effectiveness are relatively higher than earlier methods.

The practice of finger independence has been valued as early as Bach's time. First, people thought that each finger should be trained equally, especially in terms of strength, to obtain the same ability. Then the high finger method became popular for a while, which made people think that the high finger method is a

life-saving tool to help acquire finger independence. Next, another method derived from the high finger became mainstream: holding down two or four adjacent keys with fingers and striking the keys with the remaining fingers. The first systematic description of this method is in the book, *Anweisung das Pianoforte mit Hülfe des Handleiters Spielen zu lernen = Méthode pour apprendre le piano à l'aide du guide-mains: oeuvre 108*, which written by Kalkbrenner, and it was published around 1832 or 1833 in Leipzig. Since then, Herz, Richardson, and others have put forward similar practice methods. They believe that when students are striking the keys through the high finger, it can strengthen fingers and separate fingers more effectively. Even in the 20th century, it was still the prevalent method. Liszt (1976), Pischna (1931), and Gillock (Burr & Gillock, 1976) all thought the method is helpful. Moreover, Leschetizky thought using the fourth and fifth fingers to hold down keys while the other fingers play can improve independence, and Leschetizky added that students should remember to repeat the wrist movement in practice (Brée, 1902). Bernstein believed that the high finger method is the best way to gain independence (Bernstein, 1981). Nevertheless, Fielden recognised that finger independence is affected by the nerve impulses from the stationary fingers, which are concentrated in the nerves of the moving fingers (Fielden, 1949). Therefore, when a finger is working, it is harmful to the other fingers that are holding down keys because the nerves of those fingers are also working at this time. It forces these fingers to restrain the nerve excitation and cause them to be cumbersome

and can even damage the nerves. Additionally, Last (1972), Gát (1968), Kochevitsky (1967), and Sándor (1982) are also against this approach. Therefore, this method's potential harms are worth considering. Instead, the fingers should cooperate while practising their independence and be coordinated with the wrist and arm.

A few persons have held this perception in the past three centuries, and the most famous one, undoubtedly, is Breithaupt. He believes that neither fingers nor hands cannot move entirely independently. He said,

*allow nature full freedom of action; employ both arms resolutely, intrepidly, to attain the particular or common object... freedom or dexterity of both (left and right) nerve-centres by a steady, gradual development of the organism.*¹²⁹

Relaxing the arm is crucial for independence practice, and relaxing the wrist is also very important. This is because a relaxed wrist can stabilise the finger joints (Breithaupt, 1909). For this reason, Breithaupt believed that as long as you can relax, finger independence can be obtained simultaneously. Moreover, he thought that weight and rotation can help acquire finger independence, and he realised

¹²⁹ Breithaupt, Rudolf Maria. (1909) *Natural Piano Technique Vol. 2: School of Weight-Touch-Natural Piano Technic*. Leipzig: C. F. Kahnt Nachfolger. p. 58.

that independence is closely related to the brain (the innervation of the central nervous system).

Sándor holds the same viewpoint as Breithaupt. Sándor analysed the physiological structure of the third, fourth, and fifth fingers and concluded that all fingers cannot practise independently without the help of the arm. Sándor also insisted that the five-finger exercises can achieve finger independence. (Sándor, 1982) Nevertheless, students should pay attention to avoid playing the next tone before the last key is completely restored, which is not helpful to practise finger independence, and students should pay attention with their ears (Ortmann, 1929). If the tendon of the finger can function with the connected muscle in a straight plane, the finger's movement will become smoother. Therefore, it requires the relaxation of wrists and arms and the correct playing posture, for which you can refer to *Figure 4.5* and *Figure 4.6*.

Many beginners and even instructors usually think it is necessary to practise with high fingers and force fingers to strike the piano keys because the fingers are too weak. However, the muscle strength of the fingers cannot be increased because the finger movements depend on the muscles of the forearm, including the fifth finger, which is reinforced by the rotation of the forearm (Sándor, 1982). As shown in *Figure 5.18*, each finger relates to its respective muscle in the forearm. As mentioned in Chapter II, hand muscles control all kinds of finger movements. Therefore, the most direct way to make fingers powerful is to

strengthen hand muscles. Enhancing handgrip strength perhaps is one of the quickest ways.

Furthermore, some persons believe that staccato can be used to effectively practise finger independence. Chopin believed this. He thinks that students should practise staccato before studying legato (Eigeldinger, 2011). Staccato has three types of execution, which include playing with finger, wrist, or arm. In fact, playing staccato in a slow tempo can promote finger independence. In addition, Whiteside suggested practising double notes (mainly double thirds) and trills to help the fingers gain independence. She stressed that students should not practise finger independence alone but must cooperate with hands, fingers, forearms, and upper arms (Whiteside, 1961).

In general, the exercise of finger independence should depend on the coordination and relaxation of the wrist and arm. We should abandon the old school and rely on essential physiological characteristics and modern methods. As Leschetizky (Brée, 1902) and Gát (1968) said, finger independence needs to be controlled by the brain, which is consciousness, and students must learn to control fingers under conscious direction. This helps form unconditioned response, and finally they can obtain finger independence (Brée, 1902). Moreover, Gát's physical exercises are comprehensive, and he has designed special exercises for lots of techniques such as octaves, skips, and so on. In these exercises, repeated vertical and horizontal motion enables the joints from

shoulder to the fingers to activate all prominent playing organs (Gát, 1968). Furthermore, the contemporary studies have revealed that pianist's fingers have more nerve cells, especially the nerve cells in the ring finger are more than in the index finger; however, no matter how the fingers move, there is no significant change in the related areas of the pianist's brain (Furuya, 2012). This further proves that the formation of unconditioned response is inevitable for finger independence. Exercises may not only be on the keys but can also train the brain through physical practice. For physical practice, Mikimoto invented a training board according to the human hand's physiological properties, as shown in *Figure 5.19*,

Figure 5.19

Mikimoto training board



Source: トレーニングボードピアノ練習補助木製. Retrieved from <https://www.amazon.co.jp/トレーニングボード-ピアノ-練習補助-T-80-木製/dp/B075MxDYHBB> (Accessed on Feb 28, 2022)

The purpose of the training board is to practise finger independence and hand position. By installing different numbers of small round wood pieces, the users

can train fingers in different ways according to necessity. Mikimoto also offered another method to practise finger independence and strength: Palm downward, put the wrist and arm on the table and keep relaxed, then use the muscles of the arm to lift and then put down each finger in turn. Next, put the palm upward, then hang a small object (about 50g) on the index finger, then bend the finger inward toward the palm. Finally, put it back to the original place. (Mikimoto, 2010) It is a way to strengthen the fingers. For specific practice methods, students and instructors can refer to Mikimoto's method book.

In addition, when practising the fourth finger, students should notice its particular physiological structure, and should not force it to move, but try to use its muscles connected with the arm to control the activity. Furthermore, the fifth and first fingers are particular patterns because there are independent muscles. While using the arm muscles that connect with their tendons, you should also corporately use related hand muscles. These methods follow the basic coordination principle of the arm, wrist, and finger, which can lead adolescent beginners to understand the coordination function between arm and hand muscles. It is also a physical application of Breithaupt's method.

5.5 Conclusion and Supplements

This chapter discusses pedagogies and methods for adolescent beginners by seeking out method books of the past three centuries, consulting contemporary

scientific research, and heeding the characteristics of adolescents. These effective instruction strategies and practice methods are discussed in four aspects: 1) postures; 2) relaxation and coordination; 3) score reading and music learning; 4) the playing difficulties encountered by adolescent beginners (scales, arpeggios and finger independence). These four aspects are also the basic steps for adolescent beginners to learn piano. In other words, posture – relaxation – music theory – techniques, which reflects the adaptability of adolescent's physiological and psychological properties, as well as the significance of physical coordination and mental practice. Referring to these learning steps can help adolescent beginners study and practise piano effectively. In addition, ear and rhythm training are also crucially important in the early stage.

Moreover, it can also be concluded that posture, relaxation, and coordination affect piano performance at the physical level, while musicality affects piano performance at mental and psychological levels. Musical image is closely related to muscle activity, and the piano playing action corresponds to the aural image (Gát, 1968). The touch perception of the fingers and muscle locomotion also affect the timbre because the vibration frequency of each sound is felt by touching the key (Fassina, 2000). Muscle contraction and nerve conduction in different movements reflect different musical images and timbral effects, which means that aesthetic sense determines the music expression served by techniques. Therefore, the cultivation of this aesthetic sense is important for adolescent beginners. From Chapter II, we can see the characteristics of adolescent

beginners in psychology and cognition. Although they cannot adapt to piano playing rapidly due to their physical structure, they have more advantages in terms of musical understanding. According to my own learning experience, studying musical interpretation at first is effective. The difficulties of any finger techniques can be solved by music, rather than through physically repeated practice. The following sections will supplement some advanced methods for daily practice and provide exercise repertoires for adolescent beginners.

First, regarding daily practice time: In the past, most methods thought that three or four hours each day for practice was the most appropriate. Breithaupt recommended one of two regimens: Amateur students need one or two hours, and professional students need three or four hours (Breithaupt, 1909). However, according to the survey results in Chapter III, non-professional adolescent beginners spend about forty-five minutes to two hours, while professional students spend about two to three hours every day. However, modern scientific research reveals that three hours and forty-five minutes for daily piano practice is the most appropriate time even for professional students (Furuya, 2012). More extended practice causes fatigue and has a higher risk of deleterious effects on hand muscles. Therefore, it is suggested that adolescent beginners practise for one hour every day when they just start to study the piano, and it should include relaxation exercises. Then gradually increase to two hours, during which time students need to review old pieces and practise new works. Indeed, if the student wants to be a professional player, he needs to practise for three hours every day.

During the three hours, except reviewing and practising the new content, the student should read and understand the music carefully and simultaneously memorise the score as fast as possible.

Then, instructors should not force beginners to play loudly but touch the key correctly with relaxation and coordinated locomotive organs, even if the sounds are weak. This has been approved by Breithaupt, Gát and other past educators. Furthermore, when beginners are practising, instructors should constantly remind them to rest to prevent muscle fatigue (Brée, 1902). Instructors should help beginners develop their sense of rhythm and learn musical terms to understand the musical contents. At the same time, in order to help students play smoothly, teachers should also correct students' fingerings, because the three foundations of playing the piano – notes, fingerings, and counting are essential. Also, Newman suggests students who can already play Bach's inventions should begin new pieces through the following steps: 1) Select the piece and decide the fingerings and find the appropriate key-touch techniques; 2) Practise slowly with the metronome, find the rhythm of the music, and memorise the score simultaneously; 3) Follow the metronome to play in tempo, and then separate it into several small sections to practice. (Newman, 1984) Here you should carefully analyse the details like the phrasings. I believe this is an effective traditional learning method. Although memorisation is required in the second step, that is difficult. However, the earlier you remember the score, the better you can focus on playing and music. In my opinion, due to the memory function of

human muscles and nerves, I prefer to divide the music into several small segments according to the phrasings and practise it in tempo during step 2), after that student can practise slowly with the metronome in step 3). This is because, if you practise in a slow tempo at the beginning, the brain will receive different action information from the original speed, which could lead to lower efficiency in practice later. On the contrary, if you start practising in the original tempo, the hand and arm actions and muscle functions will be remembered by the brain, and in later practice, even at a slow tempo, your locomotive organs can coordinate according to the original tempo. In other words, whether in a slow or fast tempo, we should ensure the formation of the same muscle coordination and action. Mechanics and music development are integrated; beginners should browse many music scores to create a connection between visuals and physical performance (Gát, 1968), and always remember that music and mechanics are a complete whole, because “*music + mechanics = technique*”.

Next, I must emphasise the importance and necessity of physical exercise again. Firstly, the purpose of physical exercises is to relax the locomotive organs and make their neuromuscular systems coordinate with each other more naturally and reasonably. Secondly, muscle activity and function cannot be fully utilised for playing instruments. Thirdly, the actions involved in instrument playing are highly controlled. Furthermore, physical exercise should be a relaxing movement, which can help the muscles find a naturally relaxed state rapidly and adapt to coordination functions. Therefore, the students should do these physical

exercises appropriately to avoid muscle and body fatigue. Also, when some parts of the body are doing the exercise, other parts that are not in use should keep relaxed. Moreover, students should always notice the stability and fluency of breathing during the physical exercises because smooth breathing can ensure that lactic acid is dissolved and provide sufficient oxygen, which is necessary for the efficient operation of the brain and long-term playing.

Last, I would like to provide some works to practise for adolescent beginners. These repertoires may not be familiar, but they were widely used by plenty of famous musicians and educators in the past centuries. From the pedagogies of the past three centuries, few methods include systematic teaching repertoires. After sorting them out, only Chopin, Plaidy, and Pauer introduced teaching repertoires in their pedagogies. Moreover, through my practical playing and analysis, I have come to consider them valuable works that should be re-recognised and re-studied. Also, these works are good choices for those students who started learning piano after age ten, because teachers such as Chopin also guided several late beginners by using the following works. I also integrated Plaidy and Pauer's repertoires, and they are separately listed with Chopin's repertoires.

Table 5.1

Chopin's practising repertoires for adolescent beginners

Bach, J. S.	- Suites (French, English, Partita) - The Well-tempered Clavier: 48 Preludes and Fugues
Beethoven, L. v.	- Piano Sonatas Op. 26, Op. 27 No. 2 and Op. 57
Clementi, M.	- Preludes and Exercises, and Gradus ad Parnassum
Cramer, J. B.	- Studies
Hummel, J. N.	- Piano Sonatas Op. 81
Mendelssohn, F.	- Songs Without Words
Moscheles, I.	- 24 Etudes, Op. 70 - 12 The Characteristic Etudes, Op. 95
Weber, C. M. v.	- Piano Sonatas Op. 24 and Op. 39

*Made by the author

According to Chopin's disciples, after practising the works listed above well enough, Chopin would give students his works such as Etudes Op. 10 and Op. 25 to practise; Chopin guided late beginners in scale study by using Clementi's Preludes and Exercises, No. 1, and he demanded that students practise these pieces with vivid and soft sounds, however, Chopin's teaching methods do not include any of Schumann's works (Eigeldinger, 2011). Except Beethoven, Mendelssohn, and Bach, Chopin also provided works written by Moscheles, Cramer, Hummel, and Weber. Their works also convey a range of musical characters, especially their sonatas and etudes. Technically speaking, their works are not as complicated as Chopin or Liszt, and it is easier to use fingers while playing them. Furthermore, in the music of Chopin, Saint-Saëns, Schumann, and Liszt, some musical features and styles and even playing skills are similar to Hummel, Weber, and Moscheles. Therefore, for adolescent beginners, in the

early and middle stages of learning, Chopin's repertoires for teaching are valuable for study.

Plaidy and Pauer have given suggestions on the selection of repertoire to practise in their method books (Plaidy, 1852) (Pauer, 1877). I summarised their suggestions according to the following three levels to provide adolescent beginners and instructors a list of choices.

Table 5.2

Plaidy and Pauer's repertoires for the beginners

Berens, H.	- Neueste Schule der Geläufigkeit, Op.61 - 12 Etudes de Genre, Op. 73 - 20 Etudes enfantines, Op. 79
Bertini, H.	- 25 Etudes Faciles et Progressives, Op. 100
Clementi, M.	- Preludes and Exercises, Op. 43 - Gradus ad Parnassum, Op. 44
Czerny, C.	- 100 Progressive Studies, Op. 139 - The School of Velocity, Op. 299 - 40 Daily Studies, Op. 337
Duvernoy, J. B.	- 25 Elementary Studies, Op. 176
Enckhausen, H. F.	- Des Pianoforte-Spielers erste Studien, Op. 63
Gurlitt, C.	- 24 Easy Melodious Studies, Op. 50 - 24 Melodious Studies of Medium Difficulty, Op.51 - 20 Studies in Rhythm and Expression, Op. 52 - 53
Heller, S.	- 25 Etudes, Op. 47
Köhler, L.	- Die leichtesten Etüden, Op. 151 - Die ersten Etüden für jeden Klavierschüler als technische Grundlage der Virtuosität, Op. 50
Krause, E.	- 4 Klavierstücke, Op. 4
Lernoine, H.	- Études enfantines, Op. 37
Loschhorn, A.	- 33 Etudes progressives et doigtées, Op. 66
Schmitt, A.	- Etudes, Op. 16

*Made by the author

Table 5.3

Plaidy and Pauer's repertoires for the advanced students

Bach, J. S.	- Inventions, BWV 772 – 786
Bertini, H.	- 24 Etudes, Op. 29 - 24 Etudes, Op. 32
Clementi, M.	- Toccata in B ^b major, Op. 11
Cramer, J. B.	- Studies
Czerny, C.	- The Art of Finger Dexterity, Op. 740 - Toccata in C major, Op. 92
Döring, K. H.	- Studien und Etüden für das Pianoforte, Op. 24 - Rhythmische Studien und Etüden für das Pianoforte, Op. 30
Heller, S.	- 25 Etudes Mélodiques, Op. 45, - 30 Etudes Progressives, Op. 46
Kessler, J. C.	- 24 Etudes, Op. 20
Köhler, L.	- Neue Geläufigkeitsschule für Klavier, Op. 128
Loschhorn, A.	- 18 Etüden in fortschreitender Ordnung, Op. 67
Mayer, C.	- Grand Toccata in E major - 12 Studien, Op. 119 - Ecole de la Velocité, Op. 200
Moscheles, I.	- 50 Preludes, Op. 73
Müller, B.	- 3 Caprices, Op. 70
Onslow, G.	- Toccata in C major, Op. 6

*Made by the author

Table 5.4

Plaidy and Pauer's repertoires for the more advanced students

Bach, J. S.	- The Well-tempered Clavier: 48 Preludes and Fugues
Bennett, W. S.	- 6 Etudes in the Form of Capriccios, Op. 11
Berger, L.	- 15 Etudes, Op. 12 - 15 Etudes, Op. 22
Chopin, F.	- 12 Etudes, Op. 10 - 12 Etudes, Op. 25
Czerny, C.	- The School of the Legato and Staccato, Op. 335 - Variations Brillantes on "Conversations Walzer", Op. 353
Döhler, T.	- 12 Etudes de concert, Op.30
Goldschmidt, S.	- 12 Concert Etüden, Op. 13
Heller, S.	- The Art of Phrasing, Op. 16
Henselt, A. v.	- 12 Études caractéristiques, Op. 2 - 12 Études de salon, Op. 5
Hiller, F.	- Etudes, Op. 15

Kalkbrenner, F. W.	- Souvenirs de “Zanetta”, Op. 145
Köhler, L.	- 12 Special Etudes, Op. 112
Liszt, F.	- 3 Études de concert, S.144 - Grandes études de Paganini, S.141 - Études d’Exécution Transcendante, S 139
Mendelssohn, F.	- 6 Preludes and Fugues, Op. 35 - 3 Preludes, Op. 104a - 3 Etudes, Op. 104b
Moscheles, I.	- 24 Etudes, Op. 70 - 12 The Characteristic Etudes, Op. 95
Schumann, R.	- Symphonic Etudes, Op. 13 - Toccata, Op. 7 - Etudes after Paganini Caprices, Op.3 - 6 Concert Etudes after Paganini Caprices, Op. 10
Seeling, H.	- 12 Concert Etudes, Op. 10
Taubert, W.	- 12 Études de Concert, Op. 40
Thalberg, S.	- 12 Etudes, Op. 26

*Made by the author

Chapter VI: Conclusion

This dissertation was formed in response to the state of the piano education environment in contemporary China. Although more and more adolescent students are starting to learn piano, for these students, the teaching methods are not perfect. Thus, those students learn piano with low efficiency, whereas Chinese society has higher and higher requirements for artistic accomplishment in school education. Therefore, discovering how to help those students practice the piano scientifically and efficiently and providing a set of reasonable pedagogies for instructors become an urgent task. On the other hand, the reform of traditional empiricism in teaching is also a primary task in the current science and information era. At the same time, understanding music by idealism also needs the support of materialist theory. Music should not be only felt, but also needs to be comprehended scientifically by music and instrument learners. Therefore, for instructors, this study has presented several scientific and efficient strategies to help them guide adolescent beginners.

From the perspective of physiology and physics, this study has discussed the characteristics of adolescence, and the problems that current adolescent beginners and teachers face have been discovered through a questionnaire survey. These problems have been discussed in relation to solutions provided by the methods and pedagogies from the past three centuries. Finally, I have discussed the mechanics of piano playing and provided a set of scientific practice methods

for adolescent beginners and an educational reference for the instructors.

Chapter II discusses the physiological characteristics in adolescents related to piano playing in five aspects: muscle strength, hand structure, flexibility, motor skills, and proprioception. Compared with early childhood, body maturity in adolescence develops rapidly and changes significantly; male and female hormone levels affect muscle density and bring changes in muscle strength. In adolescence, the hand strength of a male is usually more robust than that of a female. However, it can be strengthened by physical exercise. The development of hand bones and phalanges in males and females is also different at different ages. Females generally develop between the ages of 13 ~ 15, while males develop between the ages of 14 ~ 16, and the strength of the hand structure and phalanges can be enhanced through physical exercises. The development of adolescent skeletons leads to decreased flexibility, especially in males; also, the cartilage which is one of the main factors affecting flexibility is thicker than in females. At the same time, physical exercise can also ameliorate the lack of flexibility. In summary, the instructors need to arrange learning plans reasonably according to the characteristics of adolescent students at different ages and guide them through some physical exercises for additional training to improve physical function. Finally, concerning motor skills and proprioception, they influence mobility and decrease with age. Moreover, proprioception is directly related to motor skills and the precision of fingers' tactile sense. Understanding these physiological principles can lay a scientific foundation for instructors when

making teaching plans.

Chapter III, through questionnaire research and interviews, has presented the difficulties that adolescent beginners face and how teachers guide them. The study has found that adolescent beginners' sensitivity to music (including solfeggio), key touch, and finger use (independence) are not good as the early beginners. The results have revealed that adolescent beginners think these are the most difficult piano learning and practice content. However, the reasons for these difficulties the students realized can be found in Chapter II. They are caused by the changes in proprioceptive and motor skills in adolescence. The conclusion has provided a scientific basis for adolescent beginners and teachers to know the relevant factors so that they can arrange piano practice and teach effectively. Moreover, teachers believe that playing posture, score reading, and music theory are the most critical steps when teaching adolescent beginners. Furthermore, the research also obtained some psychological conclusions, which showed that adolescent beginners' emotions during piano practice are directly proportional to daily piano practice time, while the early beginners reflected a correlation between emotions and practice time. This chapter has provided an essential foundation for understanding the difficulties adolescent students face in practice and learning, and also for teachers to determine how to help those students. Also, it has grounded the core content of this study –the methods and pedagogies proposed in Chapter V.

In Chapter IV, I reorganised and re-explored the pedagogies and methods of the past three centuries. On one hand, from the perspective of historical value, this research has studied more than forty method books, from which the teaching methods of Hummel, Philipp, and Chopin have been contextualized. They not only made outstanding contributions to piano music, but also put forward many far-reaching methods in education, which include the methods for late beginners. On the other hand, with the progress of society and the development of science and technology, these methods have gradually transformed piano education from empiricism to justified pragmatism. Moreover, those methods put forward multiple scientific hypotheses, later verified by contemporary researchers with high-tech equipment. Finally, those methods give inspiration and impetus to the quest to develop more efficient and reasonable practice methods and pedagogies. Also, in this study, the practice methods and pedagogies that can be used for adolescent beginners, which lays a theoretical foundation for the research of the next chapter.

Chapter V has presented a series of methods strategies for instructors to help them guide adolescent beginners. The learning order for adolescent beginners should focus on posture, relaxation, and coordination first, then music learning, including music theory and score reading, and finally performance techniques. The methods given concerning playing posture, relaxation, and coordination have proven scientific and effective. Therefore, they should be widely popularised among adolescent beginners. On the other hand, learning music theory and score

reading has always been considered effective based on the informal observations of teachers, but has been gradually proved to be reasonable by modern scientific means. Concerning playing techniques, I have theoretically verified the scientificity of postures, scales and arpeggios, however, although these methods are effective in theory, they still lack the verification of practical feedback. Therefore, the methods I provide will need to be practised and continuously improved from feedback in the future.

The compilation of textbooks has always begun as a theoretical approach which proceeded to publication, later modified and supplemented based on the feedback received from users after long-term use. For teachers like Czerny or Hanon, their teaching materials were written and published, then the effectiveness has been proved through continuous practice by later generations. Similarly, textbooks such as Thompson have been used for many years and then modified according to the users' feedback to advance with the times to meet the needs of social development and education. However, if a method or textbook is designed and tested for a short period within a small-scale survey, the results are inaccurate and have no statistical significance. Consequently, it is an error to focus on narrow data points while ignoring the insights of generations of teachers and students. It is better to listen to the voices from practitioners who will tackle the problems in the future and lead pedagogues to make more precise textbooks and method books. Thus, as the research motivation, it will provide a theoretical basis for the complete methodology and teaching materials in the future.

This dissertation has given an overview of piano performance from the perspective of physiology and physical mechanics and inspected performance practices from macro to micro, which is rare in contemporary pedagogies. On one hand, it found that piano performance is closely related to the functions of muscle and skeleton, but the effect of the neurotransmitter conduction is more important. The quality of neurotransmitter conduction impacts key elements of performance, including finger independence (related to the number of nerve cells), score reading (related to the optic nerve), solfeggio (related to the auditory nerve), and other musical tasks (involving brain circuits). Also, the help of the respiratory system is necessary to relieve physical fatigue and physiological tension. On the other hand, the human body is an organism composed of multiple levers, from the trunk to the knuckles, and when these levers are used, gravity is the most significant influencing factor. Therefore, while making good use of your body, you should also utilize gravity, which is extremely important for economic piano playing. In addition, due to differences in age, children and adolescents have different ways to obtain information. Most children learn things and obtain information naturally and directly, while adolescents begin to rely on abstract models, making it difficult to solve problems directly and perceptually. Thus, instructors should concentrate on helping adolescent beginners grasp the principles of the piano playing before they go astray. For this reason, I am looking forward to future psychological research that can further advance piano education.

Everything in the universe has laws, from galaxies to quarks. The essence of learning any musical instrument is to learn music. Everything is changing and evolving. Musical instruments are a pure means of expression if you can learn music well. Therefore, playing technique comes from music, and music comes from the brain. The evolution of all things in the world may eventually move towards a collection of consciousness, whereas, before that, in our three-dimensional universe, consciousness ultimately needs entities to perform and express, and this is our science and technology. However, in the long river of scientific and technological development, we should recognise a philosophical truth: “After a long period of division, things tend to unite; after a long period of union, things tend to divide.” This is a generalization about history from ancient Chinese philosophy. Since ancient Greece, the division of disciplines has become more detailed, and with the social progress and scientific development, each discipline has been divided into many different research areas. However, we cannot sever the connection between disciplines, and it is a mistake to study any matter in isolation, ignoring the relevance of other areas of knowledge. Therefore, we should integrate our thinking and look for the countless connections between all things, which is indispensable for understanding our own discipline comprehensively, and which is the only way to meet the challenges faced by piano teachers in the 21st century.

BIBLIOGRAPHY

- Adam, Louis. (1804) *Méthode de piano du conservatoire*. Paris: L. Marchand.
- Adams, M. A. and W. C. Hutton. (1985) “The Effect of Posture on the Lumbar Spine.” *J Bone Joint Surg Br*, Vol. 67-B, No. 4, pp. 625-629.
- Adorno, Theodor W. and Susan Gillespie. (1993) “Music, Language, and Composition.” *The Musical Quarterly*, Vol. 77, No. 3, pp. 401-414.
- Agay, Denes (ed). (1981) *Teaching Piano: A Comprehensive Guide and Reference Book for the Instructor*. New York: Yorktown Music Press.
- Aiba, Eriko, and Toshie Matsui. (2016) “Music Memory Following Short-term Practice and Its Relationship with the Sight-reading Abilities of Professional Pianists.” *Frontiers in Psychology*, May, Volume 7, pp. 1-11.
- Aiba, Eriko, and Yutaka Sakaguchi. (2018) “Visual Information Pianists Use for Efficient Score Reading.” *Frontiers in Psychology*, Nov, Volume 9, pp. 1-14.
- Allsop, Lili and Tim Ackland. (2010) “The Prevalence of Playing-Related Musculoskeletal Disorders in Relation to Piano Players' Playing Techniques and Practicing Strategies.” *Music Performance Research (Special Issue Music and Health)*, Vol 3 (1), pp. 61-78.
- Arabi, Asma, Mona Nabulsi, Joyce Maalouf, Mahmoud Choucair, Hassan Khalifé, Reinhold Vieth, Ghada El-Hajj Fuleihan. (2004) “Bone mineral density by age, gender, pubertal stages, and socioeconomic status in health Lebanese children and adolescents.” *Bone*, Nov, 35(5), pp. 1169-1179. Doi: 10.1016/j.bone.2004.06.015
- Arthur, Patricia Jean. (2017) “Piano Music Sight Reading: The Transfer of Expertise to Non-Musical Domains and the Effect of Visual and Auditory Interference on Performance.” Ph. D. dissertation, University of New South

Wales.

Atikulac, Sibel, Marieke G. N. Bos, Lucy Foulkes, Eveline A. Crone and Jorien van Hoorn. (2019) "Age and Gender Effects in Sensitivity to Social Rewards in Adolescents and Young Adults." *Frontiers in Behavioral Neuroscience*, July, Volume 13, Doi: 10.3389/fnbeh.2019.00171.

Bach, C. P. E. (1753) *Versuch über die wahre Art, das Clavier zu spielen*. Leipzig: Breitkopf & Härtel.

Bascom, Brandon Roger. (2012) "The Legacy of József Gát on Piano Performance and Pedagogy." DMA dissertation, University of Iowa.

Batyrshina, Gulnara, and Nadezhada Shirieva. (2016) "Playing Exercises in Learning Piano for Beginners Survey of Russian Piano Methods." *The Turkish Journal of Design, Art and Communication*, Nov, pp. 2617-2625.

Mustafa Becerikli, Henriette Jaurich, Jessica Schira, Matthias Schulte, Carmen Döbele, Christoph Wallner, Stephanie Abraham, Johannes M. Wagner, Mehran Dadras, Ulrich Kneser, Marcus Lehnhardt, and Björn Behr. (2017) "Age-dependent alterations in osteoblast and osteoclast activity in human cancellous bone." *Journal of Cellular and Molecular Medicine*, Nov, 21 (11), pp. 2773-2781. Doi: 10.1111/jcmm.13192

Beek, Nathalie Van, Dick F. Stegeman, Ilse Jonkers, Chris L. de Korte, Dirk Jan Veeger and Huub Maas. (2019) "Single Finger Movements in the Aging Hand: Changes in Finger Independence, Muscle Activation Patterns and Tendon Displacement in Older Adults." *Experimental Brain Research*., May, 237 (5), pp. 1141-1154. Doi: 10.1007/s00221-019-05487-1.

Bernstein, Seymour. (1981) *With Your Own Two Hands*. New York: Schirmer.

Bertelli, J. A., K. E. Tavares (2018) "Little Finger Abduction and Adduction Testing in Ulnar Nerve Lesion." *National Center for Biotechnology Information*,

37 (6), pp. 368-371. Doi: 10.1016/j.hansur.2018.09.006

Bertini, Henri Jerome. (1848) *A Progressive and Complete Method for the Piano-forte*. Boston: New England Piano Co.

Binder, Marc D, Nobutaka Hirokawa, and Uwe Windhorst. (2009) *Encyclopedia of Neuroscience*. Berlin: Springer.

Boyle, Rhonda D. and Robin G Boyle. (2009) "Hand Size and the Piano Keyboard. Literature Review and Survey of the Technical and Musical Benefits for Pianists using Reduced-Size Keyboards in North America."

Bradshaw, Murray C., and Edward J. Soehnlén (ed). (1984) *The Transylvanian*. Ottawa: Institute of Mediaeval Music.

Branta, Crystal, John Haubenstricker and Vern Seefekdt. (1984) "Age Changes in Motor Skills During Childhood and Adolescence." *The American College of Sports Medicine*, 12(1), pp. 467-520.

Brée, Malwine. (1902) *The Groundwork of the Leschetizky Method*. New York: G. Schirmer.

Breithaupt, Rudolf Maria. (1909) *Natural Piano Technique Vol. 2: School of Weight-Touch-Natural Piano Technic*. Leipzig: C. F. Kahnt Nachfolger.

Brown, Kelly A., Dilip R. Patel, and Daphne Darmawan. (2017) "Participation in Sports in Relation to Adolescent Growth and Development." *Transl Pediatr*, 6(3), pp. 150-159.

Burr, Ruth and William Gillock. (1976) *Technic – All the Way!* Cincinnati, Ohio: The Willis Music Co.

Burred, Juan José. (2009) *The Acoustics of the Piano*. Madrid: Professional Conservatory of Music Arturo Soria.

Bush, Douglas Earl, and Richard Kassel. (2006) *The Organ: An Encyclopedia*. New York and London: Routledge.

Caland, Elisabeth. (1903) *Artistic Piano Playing as Taught by Ludwig Deppe*. New York: G. Schirmer.

Camp, Max W. (1992) *Teaching Piano: The Synthesis of Mind, Ear and Body*. Los Angeles: Dover Publications.

Cardoso, Hugo and Rino Severtino. (2020) "The Chronology of Epiphyseal Union in the Hand and Foot from Dry Bone Observations." *International Journal of Osteoarchaeology*, Nov, 20(6), pp. 737-746, Doi: 10.1002/oa.1097

Chang, Chuan C. (2016) *Fundamentals of Piano Practice*. Florida: CreateSpace Independent Publishing Platform. p. 136.

Chen, Chao-Ying, Corey W. McGee, Tonya L. Rich, Cecília N. Prudente and Bernadette T. Gillick. (2018) "Reference Values of Intrinsic Muscle Strength of the Hand of Adolescents and Young Adults." *J Hand Ther*, 31(3), pp. 348-356, Doi: 10.1016/j.jht.2017.05.012

Clementi, Muzio. (1803) *Introduction to the Art of Playing on the Piano Forte: Containing the Elements of Music, Preliminary Notion on Fingering, and Fifty Fingered Lessons*. London: Clementi, Banger, Hyde, Collard & Davis

Couperin, François. (1717) *L'art de toucher du clavecin*. Paris: Chez L'Auteur.

Couperin, François. (1974) *The Art of Playing the Harpsichord*. New York: Alfred Music Publishing.

Crede, Julia, Linda Wirthwein, Nele McElvany and Ricarda Steinmayr. (2015) "Adolescents' Academic Achievement and Life Satisfaction: The Role of Parents' Education." *Frontiers in Psychology*, Feb, Volume 6, Doi: 10.3389/fpsyg.2015.00052.

Czerny, Carl. (1839) *Pianoforte Schule*. Wien: A. Diabelli & Co.

Davis, Donald D., Steven M. Kane (2020) Ulnar Nerve Entrapment (StatPearls). Retrieved from <https://www.ncbi.nlm.nih.gov/books/NBK555929/> (Accessed on May 31st, 2021)

Deutsch, Leonhard. (1950) *Piano: Guided Sight-Reading*. Chicago: Nelson-Hall Company.

Diruta, Girolamo. (1622) *Il Transilvano*. Venice: Alessandro Vincenti.

Dussek, Jan Ladislav. (1796) *Dussek's Instructions on the Art of Playing the piano Forte or Harpsichord*. London: Corri Dussek & Company.

Dutton, Yulia E. Chentsova, In-Jae Choi and Eunsoo Choi. (2020) "Perceived Parental Support and Adolescents' Positive Self-Beliefs and Level of Distress Across Four Countries." *Frontier in Psychology*, Mar, Volume 11, Doi: 10.3389/fpsyg.2020.00353.

Eigeldinger, Jean-Jacques. (2011) *Chopin: Pianist and Teacher as Seen by His Pupils*. New York: Cambridge University Press.

Fassina, Jean. (2000) *Lettre à jeune pianiste*. Paris: Fayard.

Fielden, Thomas. (1949). *The Science of Pianoforte Technique*. London: Macmillan and Co.

Forkel, Johannes Nikolaus. (1802) *Über Johann Sebastian Bachs Leben, Kunst und Kunstwerke: Für patriotische Verehrer echter musikalischer Kunst*. Leipzig: Hoffmeister & Kühnel.

Fox, Alice J. Sophia, Asheesh Bedi and Scott A. Rodeo. (2009) "The Basic Science of Articular Cartilage: Structure, Composition, and Function." *Sports Health A Multidisciplinary Approach*, Nov, Vol 1, No. 6, pp. 461-468.

Fung Ying, Loo, et, al. (2014) "Tension Release in Piano Playing: Teaching Alexander Technique to Undergraduate Piano Majors." *Procedia-Social and Behavioural Sciences*, 174, pp. 2413-2417.

Fytika, Athina. (2004) "A Historical Overview of the Philosophy Behind Keyboard Fingering Instruction from the Sixteenth Century to the Present." DMA dissertation, Florida State University.

Gardner, Howard. (1991) *The Unschooled Mind: How Children Think and How Schools Should Teach*. New York: Basic Books Inc.

Gärtner, H., M. Minnerop, P. Pieperhoff, A. Schlecicher, K. Zilles, E. Altenmüller and K. Amunts. (2013) "Brain Morphometry Shows Effects of Long-term Musical Practice in Middle-aged Keyboard Players." *Frontiers in Psychology*, Sep, Volume 4, pp. 1-13. Doi: 10.3389/fpsyg.2013.00636

Gaston, Beunen, and Robert M. Malina. (1988) Growth and physical performance relative to timing of the adolescent spurt. *Exercise and Sport Sciences Reviews*, 16, pp. 503-540.

Gát, József. (1968) *The Technique of Piano Playing*. London: Boosey & Hawkes.

Gerig, Reginald R. (2007) *Famous Pianists and Their Technique*. Illinois: Indiana University Press.

Gilsanz, Vicente, and Osman Ratib. (2005) *Hand Bone Age, A Digital Atlas of Skeletal Maturity*. Berlin: Springer.

Goulding, Ailsa, Andrea M Grant and Sheila M Williams. (2005) "Bone and Body Composition of Children and Adolescent with Repeated Forearm Fractures." *Journal of Bone and Mineral Research*, Volume 20, N0. 12, pp. 2090-2096.

Gómez-Campos, Rossana, et al. (2017) "Proposed Equations and Reference Values for Calculating Bone Health in Children and Adolescent Based on Age

and Sex.” *PLOS ONE*, July, pp. 1-14.

Graupner, Gottlieb. (1806) *Rudiments of the Art of Playing on the Piano Forte*. Boston: G. Graupner.

Halupa, Colleen M. (2015) *Transformative Curriculum Design in Health Sciences Education*. Pennsylvania: IGI Global.

He, Liang and Pierre A. Mathieu. (2019) “Biceps Brachii Muscle Synergy and Target Reaching in a Virtual Environment.” *Frontiers in Neurorobotics*, Dec, volume 13. Doi: 10.3389/fnbot.2019.00100

Hedley, Arthur. (1962) *Selected Correspondence of Fryderyk Chopin*. (Hedley, Arthur. Trans. & Ed.) London: Heinemann.

Herz, Henri. (1838) *Méthode complète de piano*. Mainz: B. Schott's Söhne

Holst-Wolf, Jessica M., I-Ling Yeh and Jürgen Konczak. (2016) “Development of Proprioceptive Acuity in Typically Developing Children: Normative Data on Forearm Position Sense.” *Frontiers in Human Neuroscience*, August, Volume 10, pp. 1-8.

Hook, James. (1785) *Guide di musica*. London: Muzio Clementi & Co.

Hullah, Annette (1906) *Theodor Leschetizky*. London: John Jane

Hummel, Johann Nepomuk. (1828) *A Complete Theoretical and Practical Course of Instruction on the Art of Playing the Piano Forte*. London: Boosey & Co.

Hüntten, Franz. (1833) *Méthode de piano*. Paris: A. Brullé.

Ibes, Willem. (2010) “The Physics and Metaphysics of Piano Playing: Twelve Fundamental Principles.” *Music Faculty Publications*, 8.

Joh, Esther M. (2013) “Bach and Schumann as Keyboard Pedagogues: A Comparative and Critical Overview of the ‘Notebook of Anna Magdalena,’ and the ‘Album for Young’.” DMA dissertation, University of Washington.

Kalisch, Tobias, et al. (2012) “Age-related Changes in the Joint Position Sense of the Human Hand.” *Clinical Interventions in Aging*, 7, pp. 499-507.

Kalkbrenner, Friedrich Wilhelm Michael. (1830) *Méthode pour apprendre le piano à l'aide du guide-mains*. Paris: Chez I. Pleyel et Cie.

Karnovsky, Ignor A. (2012) *Theory of Arched Structure*. Berlin: Springer.

Kilby, M. C., P. C. Molenaar, and K. M. Newell. (2015) “Models of Postural Control: Shared Variance in Joint and COM Motions.” *PLoS One*, May, 10(5). Doi: 10.1371/journal.pone.0126379.

Kipnis, Igor. (2007) *The Harpsichord and Clavichord: An Encyclopedia*. New York and London: Routledge.

Klimstra, Theo. (2013) “Adolescent Personality Development and Identity Formation.” *Child Development Perspectives*, Volume 7, No. 2, pp. 80-84.

Kochevitsky, George. (1967) *The Art of Piano Playing: A Scientific Approach*. New Jersey: Summy- Birchard Music.

Krahenbühl, Tathiane, Ezequiel Moreira Gonçalves, Eduardo Tavares Costa, Antonio de Azevedo Barros Filho. (2014) “Factors that influence bone mass of healthy children and adolescents measured by quantitative ultrasound at the hand phalanges: a systematic review.” *Rev Paul Pediatr*, 32(3), pp. 266-272. Doi: 10.1590/1984-0462201432319

Kröger, Stephan and Bridgette Watkins. (2021) “Muscle Spindle Function in Healthy and Diseased Muscle.” *Skeletal Muscle*, 11:3, pp. 1-13.

Lambertz, Daniel, Isabelle Mora, Jean-Francois Grosset and Chantal Pérot. (2003) “Evaluation of musculotendinous stiffness in prepubertal children and adults, taking into account muscle activity.” *Journal of Applied Physiology*, 95 (1), pp. 64-72. Doi:10.1152/jappphysiol.00885.2002

Landelle, C., A. El Ahmadi, and A. Kavounoudias. (2018) “Age-Related Impairment of Hand Movement Perception Based on Muscle Proprioception and Touch.” *Neuroscience*, 381, pp. 91-104.

Lang, Catherine E, and Marc H Schieber. (2004) “Human Finger Independence: Limitations Due to Passive Mechanical Coupling Versus Active Neuromuscular Control.” *J Neurophysiol*, Nov, 92 (5), pp. 2802-2810. Doi: 10.1152/jn.00480.2004.

Lang, Thomas F. (2011) “The Bone-Muscle Relationship in Men and Women.” *Journal of Osteoporosis*, Volume 2011, Doi: 10.4061/2011/702735

Last, Joan. (1972) *The Young Pianist, An Approach for Teachers and Students*. London: Oxford University Press.

Latash, Mark L., Jae Kun Shim, Minoru Shinohara and Vladimir M. Zatsiorsky. (2006) “Changes in Finger Coordination and Hand Function with Advanced Age.” *Motor Control and Learning*. Ed. Mark L. Latash and Francis Lestienne. Berlin: Springer, pp. 141-159.

Latour, Jean Théodore. (1832) *New and Improved Method of Instruction for the Pianoforte*. London: S. Chappell.

Levine, Michael A. (2015) “Assessing Bone Health in Children and Adolescents.” *Indian Journal of Endocrinology and Metabolism*, Vol 16, Supplement 2, pp. S205-212.

Lillegard, Wade A., Eugene W. Brown, Daniel J. Wilson, Ruben Henderson, and Evelyn Lewis. (1996) “Efficacy of Strength Training in Prepubescent to Early

Postpubescent Males and Females: Effects of Gender and Maturity.” *Pediatric Rehabilitation*, May, Volume 1, pp. 147-157.

Lin, Chi. (2002) “Piano Teaching Philosophies and Influences on Pianism at the Central Conservatory of Music in Beijing, China.” DMA dissertation, Louisiana State University and Agricultural and Mechanical College.

Lisboa, Tania, Roger Chaffin, and Alexander P. Demos. (2015) “Recording Thoughts While Memorizing Music: A Case Study.” *Frontiers in Psychology*, Jan, Volume 5, pp. 1-13.

Liu, Lu, Na Wang and Lumei Tian. (2019) “The Parent-Adolescent Relationship and Risk-Taking Behaviours Among Chinese Adolescents: The Moderating Tole of Self-Control.” *Frontiers in Psychology*, March, Volume 10, Doi: 10.3390/fpsyg.2019.00542.

Liu, Junting, et al. (2018) “Bone Mineral Density Reference Standards for Chinese Children Aged 3-18: Crossing-sectional Results of the 2013-2015 China Child and Adolescent Cardiovascular Health (CCACH) Study.” *BMJ Open* 7, pp. 1-8.

Liszt, Franz. (1971) *Technical Exercises for the Piano, S. 146*. California: Alfred Music.

Lu, Yuanyuan. (2012) “Survey of Eighteen North-American Piano Method Books: Repertoire Selection and Categories.” MA thesis, University of Ottawa.

Ludwig, Oliver, Jens Kelm, Annette Hammes, Eduard Schmitt and Micharl Fröhlich. (2018) “Targeted Athletic Training Improves the Neuromuscular Performance in Terms of Body Posture Form Adolescence to Adulthood-Long-Term Study Over 6 Years.” *Frontiers in Physiology*, Nov, Volume 9. Doi: 10.3389/fphys.2018.01620.

Logier, Johann Bernhard. (1827). *A System of the Science of Music and Practical*

Composition. London: J. Green.

Lovat, Terence, Ron Toomey and Neville Clement. (2010) *International Research Handbook on Values Education and Student Wellbeing*. Berlin: Springer.

Ma, Ting. (2019) "Analysis of the Source, Influence and Countermeasure of the Academic Burden on Students in Primary School." *Examinations Research*, No.6, pp. 17-30.

Ma, Ting (2019) "Analysis of the Source, Influence and Countermeasure of the Academic Burden on Students in Primary School." *Examinations Research*, No.6, pp. 17-30.

MacRitchie, Jennifer, and Andrew P. MacPherson. (2015) "Integrating optional finger motion tracking with surface touch events." *Frontiers in Psychology*, June, Volume 6, pp. 1-14.

Madved, Loretta Marie. (1987) "The Development of Piano Student Learning Style and Recommendations for Adaptaion to Selected Piano Method Books." Ph. D. dissertation, Ohio State University.

Manna, Indranil. (2014) "Growth Development and Maturity in Children and Adolescent: Relation to Sports and Physical Activity." *American Journal of Sports Science and Medicine*, Vol 2, No. 5A, pp. 48-50.

Marlow, Neil, et al. (2019) "Hand Preference Develops Across Childhood and Adolescence in Extremely Preterm Children: The EPICure Study." *Pediatric Neurology* 99, pp. 40-46.

Marshall, Robert Lewis. (2003) *Eighteenth-Century Keyboard Music*. New York and London: Routledge.

Matthay, Tobias. (1932) *The Visible and Invisible in Pianoforte Technique*.

London: Oxford University Press.

Matthews, Peter B C. (2015) “Where Anatomy Led, Physiology Followed: A Survey of Our Developing Understanding of the Muscle Spindle, What It Does and How It Works.” *J Anat*, 227(2), pp. 104-114.

Milanovic, Therese Elaine. (2011) “Learning and Teaching Healthy Piano Technique: Training as an Instructor in the Taubman Approach.” Ph. D. dissertation, Queensland Conservatorium Arts, Education and Law Griffith University.

Milchmeyer, Jan Peter. (1797) *Die wahre Art das Pianoforte zu spielen*. Dresden: Carl Christian Meinhold.

Mills, Kathryn L. and Jeya Anandakumar. (2020) “The Adolescent Brain is Literally Awesome.” *Frontiers Neuroscience*, June, Volume 08, pp. 1-8.

Miyamoto, Yuri and Carol D. Ryff. (2011) “Cultural Differences in the Dialectical and Non-Dialectical Emotional Styles and Their Implications for Health.” *Cognition and Emotion*, Jan, 25(1), pp. 22-39.

Mora, Javier, Won-Sook Lee and Gilles Comeau. (2007) *3D Visual Feedback in Learning of Piano Posture*. Berlin: Springer.

Newman, William Stein. (1956) *The Pianist's Problems*. Boston: Da Capo Press.

Ng, Ai Kah, Noran Naqiah Hairi, Muhammad Yazid Jalaludin and Hazreen Abdul Majid. (2019) “Dietary Intake, Physical Activity and Muscle Strength Among Adolescents: The Malaysian Health and Adolescents Longitudinal Research Team (MyHeART) Study.” *BMJ Open*, 9: e026275, Doi: 10.1136/bmjopen-2018-026275

Noulis, Christos. (2014) “Somatic Education and Piano Performance.” Ph. D. dissertation, Birmingham City University and Birmingham Conservatoire.

Novara, Tom J. (2015) "A Comparative Analysis of the Writings and Technical Approach of Ludwig Deppe and His Contemporaries in Piano Pedagogy." MA thesis, Southern Illinois University Carbondale.

Ohtsuki, Tatsuyuki. (1981) "Decrease in grip strength induced by simultaneous bilateral exertion with reference to finger strength." *Ergonomics*, Volume 24, pp. 37-48.

Ortmann, Otto. (1929) *The Physiological Mechanics of Piano Technique*. London: Kegan Paul, Trench, Trübner & Co.

Österland, Catharina, Liu JingXia, Lars Eric Thornell, and Per Olof Eriksson. (2011) "Muscle spindle composition and distribution in human young masseter and biceps brachii muscles reveal early growth and maturation." *The Anatomical Record*, 294, pp. 683-693

Page, Zoey E, Stephanie Barrington, Jacqueline Edwards and Lisa M Barnett. (2017) "Do active video games benefit the motor skill development of non-typically developing children and adolescents: A systematic review." *J Sci Med Sport*, 20(12), pp. 1087-1100. Doi: 10.1016/j.jsams.2017.05.001

Pauer, Ernst. (1877) *The Art of Pianoforte Playing*. London: Novello, Ewer & Company.

Philipp, Isidore. (1908) *Complete School of Technic for the Pianoforte*. Philadelphia: Theodore Presser.

Pischna, Josef. (1931) *Technical Studies: Sixty Progressive Exercises, Containing Studies on Trills, Scales, Chords, Passages and Arpeggios*. New York: G. Schirmer.

Plaidy, Louis. (1852) *Technische Studien für das Pianoforte spiel*. Leipzig: Breitkopf & Härtel.

Proske, Uwe and Simon C. Gandevia. (2012) “The Proprioceptive Senses: Their Roles in Signalling Body Shape, Body Position and Movement, and Muscle Force.” *Physiol Rev*, 92, pp. 1651-1697.

Rabinof, Sylvia. (1986) “Rules for Young Musicians Robert Schumann.” *Junior Keynotes*, Winter, pp. 34-36.

Rameau, Jean Philippe. (1724) *Méthodes pour la mécanique des doigts ou l'on enseigne les moyens de se procurer*. Paris: Chez L'Auteur.

Raine, Sally, and Lance Twomey. (1994) “Posture of the Head, Shoulder, and Thoracic Spine in Comfortable Erect Standing.” *Australian Physiotherapy*, Vol 40, No. 1, pp. 25-32.

Richardson, Nathan. (1859) *New Method for the Piano-forte*. Boston: Oliver Ditson & Company.

Riggs, B Lawrence, L Joseph Melton Iii 3rd, Richard A Robb et all. (2004) “Population-Based Study of Age and Sex Differences in Bone Volumetric Density, Size, Geometry, and Structure at Different Skeletal Sites.” *J Bone Miner Res*, Dec, 19(12), 1945-54. Doi: 10.1359/JBMR.040916

Roemmich, James N and Alan D Rogol. (1995) “Physiology of Growth and Development. Its Relationship to Performance in the Young Athlete.” *Clinics in Sports Medicine*, 14(3), pp. 483-502.

Rose, Jessica, V. Jones. (1998) “Postural balance measurements for children and adolescents.” *Journal of Orthopaedic Research*, volume 16, Issue 2, pp. 271-275.

Ruggeri, Silvia and Giampiero I. Baroncelli. (2006) “Effects of sports training in adolescence on growth, puberty and bone health”. *Gynecological Endocrinology*, Vol 22, pp. 605-612.

Sabzevari, Vahid Reza, Amir Homayoun Jafari, and Reza Boostani. (2017)

“Muscle synergy extraction during arm reaching movements at different speeds.” *Technology and Health Care*, 25, pp. 123-136. Doi: 10.3233/THC-161256

Sakai, Naotaka. (2002) “Hand pain attributed to overuse among professional pianists: a study of 200 cases.” *Medical Problems of Performing Artists*, 17(4), pp. 178-180.

Sams, Eric. (1971) “Schumann’s Hand Injury.” *The Musical Times*, Vol. 112, No. 1546, pp. 1156-1159.

Sándor, György. (1982) *On Piano Playing: Motion, Sound and Expression*. New York: G. Schirmer.

Scharwenka, Xaver. (1907) *Methodik des Klavierspiels*. Leipzig: Breitkopf & Härtel

Schönau, E, E Werhahn, U Schiedermaier, E Mokow, H Schiessl, K Scheidhauer, D Michalk. (1996) “Influence of Muscle Strength on Bone Strength during Childhood and Adolescence.” *Horm Res*, 45, pp. 63-66. Doi:10.1159/000184834

Shamoto, Yoshiko. (2013) “Piano-Related Musculoskeletal Disorders: Posture and Pain.” DMA dissertation, University of North Texas.

Shin, Dong-Ok and Seung-Houn La. (2005) “Biomechanical Analysis with the Force of Deltoid Muscle for Pianist.” *International Journal of Safety*, Vol. 4, No. 1, pp. 27-31.

Smahel, Z and A Klímová. (2004a) “The Influence of Age and Exercise on the Mobility of Hand Joints: 1: Metacarpophalangeal Joints of the Three-Phalangeal Fingers.” *Acta Chirurgiae Plasticae*, 46(3), pp. 81-88.

Smahel, Z and A Klímová. (2004b) “The influence of age and exercise on the mobility of hand joints: 2: Interphalangeal joints of the three phalangeal fingers.” *Acta Chirurgiae Plasticae*, 46(4), pp. 122-126.

Smahel, Z and A Klímová. (2005a) “The influence of age and exercise on the mobility of hand joints: 3. thumb joints.” *Acta Chirurgiae Plasticae*, 47(2), pp. 47-50.

Smahel, Z and A Klímová. (2005b) “The effect of age and exercise on wrist mobility.” *Acta Chirurgiae Plasticae*, 47(3), pp. 92-97.

Spannow, Anne Helene, Mogens Pfeiffer-Jensen, Niels T. Andersen, Troels Herlin and Elisaneth Stenbøg. (2010) “Ultrasonographic Measurements of Joint Cartilage Thickness in Healthy Children: Age- and Sex-Related Standard Reference Values.” *The Journal of Rheumatology*, Dec, 37(12), 2595-2601, Doi: 10.3899/jrheum.100101

Spencer, Charles Child. (1853) *The Rudiments of the Art of Playing the Pianoforte*. London: J. Weale.

Steibelt, Daniel. (1805) *Méthode de piano*. Leipzig: Breitkopf & Härtel.

Tetzel, Eugen. (1909) *Das Problem der modernen Klaviertechnik*. Leipzig: Breitkopf & Härtel.

Türk, Daniel Dott. (1789) *Klavierschule oder Anweisung zum Klavierspielen für Lehrer, mit kritischen Anmerkungen*. Leipzig & Halle: Schwickerti.

Viel, Sebastien, Marianne Vaugoyeau and Christine Assaiante. (2009) “Adolescence: a transient period of proprioceptive neglect in sensory integration of postural control.” *Motor Control*, 13 (1), pp. 25-42. Doi: 10.1123/mcj.13.1.25

Whiteside, Abby. (1961) *Indispensables of Piano Playing*. New York: Charles Scribner’s Sons.

Wristen, Brenda G. (1998) “Overuse Injuries and Piano Technique: A Biomechanical Approach.” Ph. D. dissertation, Texas Tech University.

Xu, Mo. (2018) “The High Finger Piano Technique in China: Past, Present, and Future.” DMA dissertation, University of Iowa.

Yoshimura, Eri, et, al. (2008) “Risk Factors for Piano-related Pain among College Students.” *Medical Problems of Performing Artists*, Sep, pp. 118-125.

Zhang Peng, Yanhe Deng, Xue Yu, Xin Zhao and Xiangping Liu. (2016) “Social Anxiety, Stress Type, and Conformity Among Adolescents.” *Frontiers in Psychology*, May, Volume 7, Doi: 10.3389/fpsyg.2016.00760.

Zhao, Yukun, Feng Yu, Yiwen Wu, Guang Zeng and Kaiping Peng. (2019) “Positive Education Interventions Prevent Depression in Chinese Adolescents.” *Frontiers in Psychology*, June, Volume 10, Doi: 10.3389/fpsyg.2019.01344.

Chinese References

黄立帆、金承基：《钢琴快速演奏的生理机制及训练》，《钢琴艺术》，1999年第2期，pp. 42-43.

姜力：《钢琴演奏技能与人体运动科学理论相关性研究论述—以莱默尔、迦特、布鲁瑟尔有关研究为例》，《音乐创作》，2010年第5期，pp. 166-168.

姜力、刘慧佳：《手部训练操与手指机能的训练》，《乐器》，2014年第1期，pp. 57-59.

林捷：《从生理运动角度谈钢琴启蒙教育中指与臂的关系》，《中央音乐学院学报》，1995年第2期，pp. 70-72.

秦际凯：《钢琴弹奏法的核心技术—力量—质疑“重量弹奏法”》，《钢琴艺术》，2007年第10期，pp. 36-47.

谢承峯：《试论钢琴技术训练的争议—基于生理学与物理学视角下的理论探析》，《钢琴艺术》，2018年第12期，pp. 12-20.

闫大卫：《钢琴演奏中的反作用力及其应用》，《音乐探索》，2010年第4期，pp. 60-63.

姚文君：《对中国钢琴启蒙教育的现状分析》，《黄河之声》，2017年第24期，p. 86.

Japanese References

児玉裕巳、石隈利紀、外山美樹 (2017) 「中学・高校生における学習の態度の認知・情緒・行動間の関連および学校段階間の差異」『筑波大学心理学研究』第 53 号、pp. 33-40。

境田雅章、藤井勝紀、穂丸武臣、花井忠征、酒井俊郎 (2007) 「幼児の身体組成および骨密度 (SOS 値) の加齢変化と身体組成間の関係」『発育発達研究』第 35 号、pp. 1-9。

田中望、藤井勝紀 (2010) 「児童・青少年期における身体的発育・発達曲線に関する解析-男子についての解析-」『愛知工業大学研究報告』第 45 号、pp. 27-36。

中村隆一、斉藤宏、長崎浩 (2006) 『基礎運動学』医歯薬出版社株式会社。

古屋晋一 (2012) 『ピアニストの脳を科学する超絶技巧のメカニズム』春秋社。

松本剛、山下美恵 (2020) 「中学生を対象とした『生きる意味』に関わる授業開発の試み」『兵庫教育大学研究紀要』第 56 巻、pp. 95-104。

三上香子、堀薫夫 (2014) 「アンドラゴジーの視点からみた成人のピアノ教育における学習指導に関する研究」『音楽学習学会誌「音楽学習研究」』第 10 巻、pp. 49-60。

御木本澄子 (2010) 『正しいピアノ奏法』(第 16 刷発行) 音楽之友社。

森朝(2019)『ピアニストのためのアレクサンダー・テクニーク』ヤマハミュージック。

ヤンケ、アンスガー・晴美ヤンケ (2016) 『ピアノ・テクニクの科学』アルテスパブリッシング。