

TENOR TROMBONE EXERCISES FOR UNDERGRADUATES AND THE USE OF THAI VOWELS

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Abstract

In course of researching the teaching of European musical instruments used in the Asian context, we need to remember basic issues. Trombone is an instrument that requires precise command of breath control and oral movement. Various methods of improving these key skills for trombonists have been carefully crafted, such as etudes, method books, and exercises, which greatly benefit trombone students. However, these methods are either difficult to acquire or unavailable in Thailand. Most method books are mainly written in English or foreign languages, creating a language barrier for Thai trombone students who are not well-versed in these foreign languages. Thus, the practice of teaching oral movement to trombone students is still lacking in Thailand. This results in obstacles for Thai trombonists to play certain classic pieces with a wide range, which requires a high level of both breath control and oral movement. This study aims to (a) create exercises to connect all ranges from low to high register in one breath by incorporating the use of Thai vowels to teach breath control and oral movement to music students who major in trombone in their bachelor degree and (b) determine the efficacy of the exercises. The exercises use the selected section of *T-Bone Concerto* by Johan de Meij as a case study for pre- and post-tests. The exercises prove to be efficient in increasing the students' performance. Therefore, the exercises would benefit trombonists of all levels. Furthermore, the Thai vowels concept can also be adapted to be used as exercises for trombone students of all levels of experience and for other brass instruments.

Keywords

Trombone exercise, Breathe control, Oral movement, University student, T-Bone Concerto

INTRODUCTION

No great building is ever built on a weak foundation. In the course of fostering independent teaching and researching on teaching we need to keep this in mind. To prosper, a solid foundation is vital, whether your goal is the physical apex of a high-rise or the culmination of a skill. For trombonists, fundamental knowledge of trombone techniques is essential in developing skills to reach a higher level of expertise. Without these fundamental techniques, various complicated tenor trombone solo pieces and excerpts would be unattainable. Especially for novice trombone students, in-depth knowledge of the full capacity of the trombone, especially on ranges and techniques to achieve those ranges, serves as a vital foundation for developing skills and becoming professional trombonists. At the undergraduate level, tenor trombone students ought to be able to play the range from E2 to Bb4, which is the standard range for tenor trombone. Nevertheless, certain pieces required in undergraduate repertoire require notes higher than Bb4, such as the well-known *Concertino* by Ferdinand David (1994) that contains C5s in every movement, which is considered an important piece for trombonists as it is a repertoire for trombone major students at the undergraduate level and is often used as an audition piece for orchestras worldwide. Consequently, it is vital for trombone students to be able to cover these ranges.

Various methods have been developed to help trombonists achieve fundamental trombone techniques that are crucial for them and mostly developed in the European context. There presently exist numerous etudes, method books, and exercises for tenor trombone students that cover various areas of tenor

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trombone studies, such as the fundamental knowledge of the trombone, technique practices, the study of melodic style, clef study, etc., with some categorised by level of advancement. It is vital to choose exercises correlated to the student's skills and the music pieces' advancement. This research covers the etudes, method books, and exercises used in the Trombone Syllabus of University of Florida School of Music (Robertson, 2018) and Low Brass Curriculum of Eastman School of Music, University of Rochester (Eastman Community Music School, 2020). The research also includes interviews with Sean Scot Reed, a seasoned musician and an associate professor of music at Arkansas Tech University, and Philip Brink, a professional trombonist.

Amongst the practiced etudes, method books, and exercises, the most recommended in this regard ones are (a) *Complete Method for Trombone and Euphonium* by Arban (2010), (b) Bordogni/Rochut's *Melodious Etude for Trombone. Vol. 1* (Rochut, 2011), (c) Kopprasch's *Studies for Trombone with F-attachment* (Kopprasch, 1964), (d) Kopprasch's *Selected Studies for Tuba* (Kopprasch, 1992), (d) Tyrell's *40 Progressive Studies* (Tyrell, n.d.), and (e) Bach's *Cello Suites* (Bach, 2012). Reed (2020) commented that 45% of trombone learning is Rochut's book of typical trombone lessons such as special forms of breathing, melody, melodic figuration, etc., another 45% is articulation-based methods, and the last 10% is techniques such as two-octave modal, rotating pattern scales precisely, triplet three-octave scales, complicated lip slurs, etc. Brink (2020) recommended Kopprasch's and Rochut's as being the central methods of learning trombone, while Schlossberg's *Daily Drills and Technical Studies for Trombone* (Schlossberg, n.d.) focuses on techniques rather than melodic practices. For beginner students who wish to focus on melodic practice, the less technical etude book by Concone, *Legato Etudes for Trombone* (Concone, 1970), is preferable to Bordogni. Ervin's book (Ervin, 2011) on range building provides useful techniques on range extension. Fink's books on *legato* (Fink, 1969), F-attachment, and alto/tenor clefs are efficient tools for students who are beginners in these topics. Kleinhammer's *The Art of Trombone Playing* (Kleinhammer, 1996), along with Yeo's *Mastering the Trombone* (Kleinhammer and Yeo, 2000), also cover the majority of fundamental techniques. Sauer's edition for trombone of Milde's Volume 1 of etudes (Sauer, 2016) is suitable for developing more technical melodic sense and techniques. Reynold's *A Comprehensive Workbook for Bass Trombone and Trombone with F-attachment* is also efficient (Reynolds, 2012).

This research shows exercises, method books, and etudes play vital roles in gradually improving students' skills that may have to serve in the Asian context. However, only a few offer exercises that cover the techniques required for pieces or excerpts, especially those that require the range connection from paddle range to high range in a single breath, which does not go with harmonic series. *Basic Routines for Trombone* by Robert L. Marsteller cover wide ranges but do not include techniques for playing those ranges in one breath (Marsteller, 1974), as does *The Singing Trombone* by Charles G. Vernon (Vernon, 2012). For trombone students in Thailand, these available etudes, method books, and exercises are unavailable, difficult to attain, or attainable but difficult to comprehend due to language barrier with most being written in English or in other foreign languages translated to English, which still pose predicaments for Thai trombone students whose English language skills are not strong. Furthermore, the teaching of trombone studies in Thailand mostly focuses on breath control while overlooking oral movement, which is a key component in delivering precise notes for the tenor trombone. Therefore, undergraduate trombone students in Thailand face difficulties in developing this particular skill to cover a wide range in a single breath, limiting their capability to deliver complicated or higher-level trombone pieces found in various repertoires and auditions, which consequently poses as important obstacle to becoming efficient or professional trombonists.

This issue of oral control among Thai trombone students has never been appropriately addressed or included in curriculums in Thailand. The current trombone lessons lack focus on movement control of the oral cavity and throat, while connecting techniques in high and low ranges are not taught. Consequently, undergraduate trombone students in Thailand whose backgrounds mainly lie in school marching band with the usual range of Bb2–Bb4 for tenor trombone struggle when facing wider ranges in more complexed solo pieces of concertos and sonatas, such as the G1–C5 range in *Concerto* by Ferdinand David, which is commonly used as auditioning pieces for orchestra, or the A1–F5

range in *T-Bone Concerto* by Johan de Meij (Meij, 1997), which is taught at the undergraduate level and the study piece for this research.

To address this issue, this study considers the use of known Thai vowels to train oral control for better range connection in undergraduate tenor trombone students. Several studies suggest the use of language to improve performance on wind instruments, notably the use of vowels. Christine Marie Mounger (2012) found a correlation between muscle movement while speaking languages and playing the trombone in her doctoral essay. Matthias Heyne, Donald Derrick, and Jalal Al-Tamimi (2019) found a similar conclusion and further emphasised the importance of tongue movement in wind instrument performance and its correlation to the musician's native language. Heyne and Derrick (2015) studied vowels and trombone playing in high, medium, and low notes and found the prevalent use of back of the tongue movement when connecting low to medium tones. This particular focus on the back of the tongue, which is also common in Thai language, inspires this study to utilise Thai vowels as part of exercise for tenor trombone students in Thailand, where there has not been any study or practice relating to or utilising language skills to improve trombonists' performance.

The objectives of this study are to (a) create exercises for trombone students at the undergraduate level that would help connect all ranges from low to high register in a single breath and (b) determine whether these exercises prove to be effective or not. The selected piece used as the study piece for practices, pre-tests, and post-tests to determine the efficacy of the exercises is *T-Bone Concerto* by Johan de Meij while using the Thai vowels system, whose oral mechanism is familiar to Thai trombone students, to teach oral movement, a key component in trombone lessons that has never been included before in the trombone curriculum in Thailand. Thus, these exercises would offer an unprecedented method and a solution for trombone students in Thailand to be able to reach a wider range. The success of these exercises would provide beneficial guidelines in range connection for both trombone students in Thailand and worldwide, paving the path for students to become professional trombonists capable of conquering challenging trombone pieces.

REVIEW OF *T-BONE CONCERTO* BY JOHAN DE MEIJ

BACKGROUND

Johan de Meij is a Dutch composer and a conductor in Voorburg with numerous awards for original compositions, symphonic transcriptions, and film score arrangements, which make him a prominent figure in the world-class repertoire of renowned ensembles (Meij, 1996). His work *T-Bone Concerto* is his first composition for solo instrument and symphonic band commissioned by the Kentucky Music Educator Association (KMEA). The piece contains three movements called "Rare", "Medium", and "Well Done". Arie Kohn Vandewaa (2017) said that the title of the piece was a play on words, with "T-Bone" serving as a double meaning for both the trombone and the steak cut, referring to various stages of the steak being cooked as the song slowly progresses to the end, where the song is "Well Done". The piece is celebrated among trombonists as it is a unique piece composed by a trombonist and a conductor. The piece itself is challenging for its requirement of stamina and various complicated trombone techniques, such as single and multiple tonguing. It expresses both rhythmic and melodic styles. The piece contains an extremely wide range, from extremely low with A1 as its lowest note to extremely high with long F5 as its highest, which have to be connected smoothly, demanding a high level of control.

T-BONE CONCERTO AND ACADEMIA

T-Bone Concerto by Johan de Meij is among the music pieces with a wide range used in trombone studies at the current undergraduate level. The piece covers an extremely wide range, as shown in the first movement with A1 as the lowest note and F5 as the highest. The concerto appears in several lists of solo pieces for senior tenor trombone students at the undergraduate level in universities in the United States for its challenging characteristics, which require good fundamental knowledge, techniques, and strength of tenor trombone skills. According to the researcher's studies, only one thesis has been done on the piece entitled *Modern Dutch Composers for the Solo Trombone* by Arie John,

which discusses the approach to *T-Bone Concerto* with method books. John suggests using Arban's method book for the articulation and style chapter for the first and third movements and using Rochut's for the second movement (Vadewaa, 2017).

THE ANALYSIS OF *T-BONE CONCERTO* BY THE COMPOSER

Meij's own analysis of the piece mentioned that, apart from the solo trombone, the chamber music ensemble also plays a vital role in introducing new thematic material and accompanies the soloist, creating a beautiful, transparent accompaniment. Parts I and II are written in the A-B-A form, displaying both technical and lyrical characteristics of the instrument. Part II first starts in Neo-Baroque style with the thematic material for the first and second movements before leading to a triumphant finale and a virtuoso conclusion. There are three versions of the solo that are different in clef. First, it is written in tenor and bass clef; however, most of the notes are written in tenor clef. In the second version, everything is written in bass clef. The last version is written in Bb treble clef.

T-BONE CONCERTO IN UNDERGRADUATE TENOR TROMBONE

T-Bone Concerto appears in some of the lists of solos for tenor trombones at the undergraduate level in universities in the United States and is last but not least, therefore, part of the Asian curriculum. The incorporation of Thai vowels will be helpful in overcoming specific difficulties. Martin G. Moisés Paiewonsky (2016) listed *T-Bone Concerto* in the senior list. Alex van Duuren (2014) listed *T-Bone Concerto* at the undergraduate senior level. Micah Everatt (2020) gives a list of representative literature, divided into levels 0–5. The list covers *T-Bone Concerto*, which appears in level 5 of the list. These aforementioned representative literature lists prove that *T-Bone Concerto* by Johan de Meij is used at the senior undergraduate level. It is one of the most challenging solo pieces for the tenor trombone, which requires good fundamentals, techniques, and strength.

THAI VOWELS AND TONGUE MOVEMENT USED FOR EXERCISES

Knowledge of oral movement is fundamental for trombone students. The lack of knowledge and control of the oral cavity hinder the player's ability to hit high or low notes. How much to open the mouth or how much wind to use at what speed all play a vital role in creating a precise tone to the ears of a knowing audience. The use of Thai vowels in practices would help the students better understand these conditions, as the vowels emphasise the position of the back of the tongue, which affects wind speed. There are five main vowels in Thai language: $\text{ā}/ i:/$ E, $\text{ē}/ \varepsilon:/$ A, $\text{ā}/ a:/$ R, $\text{ō}/ \text{ɔ}:/$ Or, and $\text{ū}/ u:/$.

E sets the back of the tongue high with a narrow oral cavity, resulting in little and fast wind fits for high ranges such as Bb4.

A sets the back of the tongue slightly lower than E, which makes the oral cavity slightly wider, resulting in slower and more wind, perfect for medium to high ranges such as F4, which requires slightly faster wind.

R sets the tongue in the most natural position compared to other vowels fitting for the medium to low range, including Bb2. Students usually struggle when they reach the Bb2 note, whether by making the oral cavity too wide causing wrong note.

Or sets the tongue slightly lower than its natural position with a wider oral cavity causing slow and more wind, which are vital to low ranges such as F2, which requires slow wind.

Au sets the tongue in the lowest position with the widest oral cavity causing the slowest and most wind fits for the trombone's pedal range, which requires very slow wind.

METHODOLOGY

The goal of this study is to create exercises that would help improve skills in connecting a wide range of notes from extreme low to extreme high for tenor trombone students at the undergraduate level in the Asian context with focuses on air control and oral movement by incorporating basic Thai vowels

as tools to teach oral movement while playing trombone pieces with a wide range. The study is a mixed-methods research with the qualitative part being the weekly reports on the samples' progress and the quantitative part being the pre-test and the post-test using a rubric score system. The piece selected for this research as a piece for the practice and the tests is *T-Bone Concerto* by the Dutchman Johan de Meij, which contains an extremely wide range from A1 to F5.

The study focuses on bar number 176–183 in the first movement, which contains a wide range and demands great control of both breath and oral movement. Seven tenor trombone students who participated as samples for this study are volunteers who are junior and senior Thai trombone students studying in bachelor degrees at various universities in Thailand with the desire to improve their skills in connecting and controlling all ranges on the tenor trombone. The students have various background experiences in tenor trombone with previous experience in playing Baroque music and concertos but have never played *T-Bone Concerto* by Johan de Meij before. All students would use a tenor trombone with an F-attachment that offers easier control of the notes. There are 14 exercises focusing on four criteria: (a) oral movement using Thai vowels and air speed; (b) middle to low register connection; (c) middle to high register connection; and (d) all registers connection, which are then divided into 5 topics for grading purposes: (1) phrasing, (2) control in low range, (3) control in middle range, (4) control in high range, and (5) connection control in all ranges. The concept of using vowels can be adapted to vowels of different languages for international students.

THE DEVELOPMENT OF THE EXERCISES

The goals of this research development are to create (a) efficient tools for data collection and skill assessments for the pre-test and post-test, (b) exercises, and (c) lesson plans based on the gathered information on range connection for tenor trombone undergraduate students (see Figure 1).

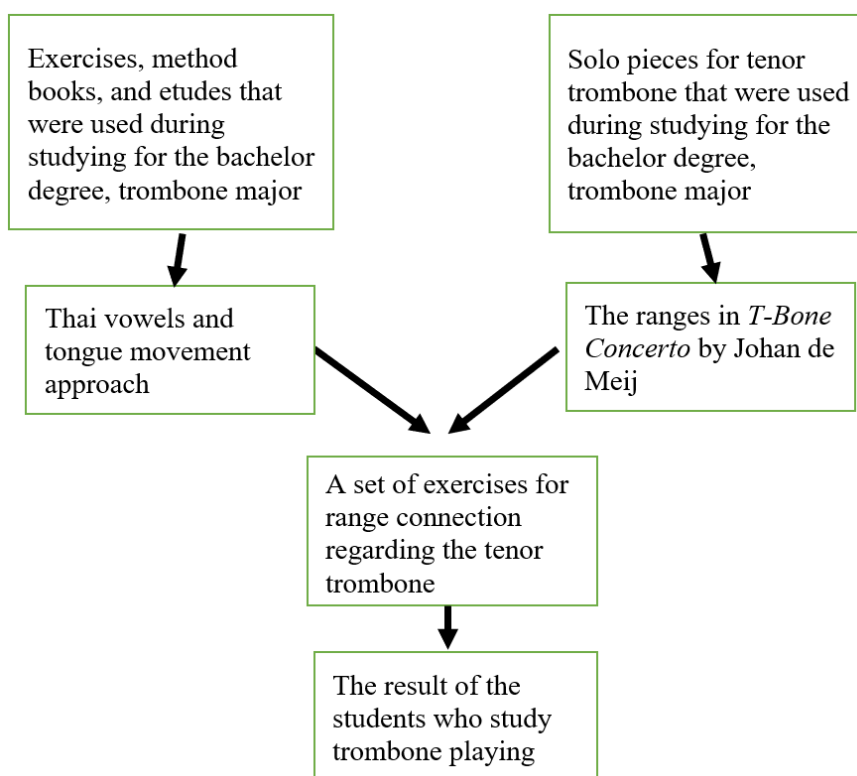


Figure 1: The researcher's conceptual framework of the tenor trombone range connection exercises.

The process of developing the exercises is divided into two phases: creating the range connection exercises and the skill assessment. The first phase of creating the range connection exercises starts with an approach based on Thai language. Thai vowels will be used as the primary key for the exercises and will be translated to English vowels for international practitioners. The first phase consists of four steps as follows:

1. Studying etudes, method books, and etudes to analyse the need for range connection on the tenor trombone.
2. Analysing the selected section in *T-Bone Concerto* by Johan de Meij, which is used as the pre-test and post-test for the range connection.
3. Creating the range connection exercises by defining the structure of the range connection exercises and the need for range connection on the tenor trombone.
4. Checking the quality of the exercises created with the advisors. Using feedback from advisors to correct and improve the exercises.

The second phase of this development is skill assessment to determine an instrument for assessing samples' progress. This phase consists of three steps, as follows:

1. Studying skill assessment methods from related research and documents that can be used to measure skills, control, and improve the samples.
2. Submitting the developed skill assessment to advisors for feedback and further improvements.
3. Applying the skill assessment to the pre-test and post-test.

THE SAMPLES

The samples and the target group for these exercises are university students at the undergraduate level. The seven samples are selected from volunteer participants from three universities in Thailand who fit the following criteria:

1. Junior or senior undergraduate students with a major in trombone are studying at a university in Thailand.
2. Able to play the notes ranging from A1 to B4 on the tenor trombone.
3. Using the tenor trombone with F-attachment in Bb/F.
4. Volunteers who wish to improve skills in connecting and controlling all ranges on the tenor trombone.
5. Have previous experience playing Baroque music and concertos.
6. Have no previous experience playing *T-Bone Concerto* by Johan de Meij.

There are seven samples as follows:

Sample 1 is a male, aged 20 years, and was born and raised in Bangkok, Thailand. The sample had played Tuba for 5 years before changing to tenor trombone. Sample 1 has been playing tenor trombone for 4 years and has been studying in a music college for 2½ years. Now, the sample is studying in junior at a music college.

Sample 2 is a male, aged 21 years, and was born in Bangkok, Thailand. The sample has been playing tenor trombone for 5 years and has been studying in a music college for 2½ years. The sample is currently studying in junior at a music college.

Sample 3 is a male, aged 21 years, and was born in the northeast of Thailand before moving to Bangkok to study music. The sample has been playing the tenor trombone for 4 years. The sample has been studying the tenor trombone seriously for 2½ years. Now, the sample is studying in junior at a music college.

Sample 4 is a male, aged 21 years, and was born in Bangkok, Thailand. At the beginning, the sample had played euphonium for 1½ year by self-study. The sample got accepted into a music high school programme as a euphonium player. The sample had changed to play a tenor trombone at the suggestion of a teacher. The sample has played the tenor trombone for 6½ years. Now, the sample is studying in junior at a music college.

Sample 5 is a male, aged 20 years, and was born in the southern part of Thailand. The sample has been playing the tenor trombone for 5 years and has been studying at a music college for 2½ years. Now, the sample is studying in junior at a music college.

Sample 6 is a female, aged 20 years, and was born in Bangkok, Thailand. The sample has been playing the tenor trombone for 9 years. At the beginning, the sample played in a school marching band for a year. Then, the sample started to have a private lesson for 4 years. In the fifth year of the sample's playing, the sample started to play in a youth orchestra. Afterwards, the sample decided to study music at a music college. Now, the sample is studying in junior at a music college.

Sample 7 is a male, aged 22 years, and was born in southern Thailand. The sample has been playing the tenor trombone for 10 years and has been studying the tenor trombone seriously for 3½ years. Now, the sample is studying in senior at a music college.

Prior to this study's practice, these samples lacked knowledge of fundamental oral movement control in trombone playing, which rendered them unable to connect between high and low registers, resulting in cracked notes, wind sounds, or playing incorrect tones in a harmonic series.

THE RESEARCH INSTRUMENTS

The instruments used in this research are (a) the exercises that cover air and oral movement, middle range to paddle range connection, middle range to high range connection, and all ranges connection; (b) bar 176-183 in the first movement of *T-Bone Concerto* by Johan de Meij to be used as pre- and post-tests; (c) skill assessment developed specifically for the pre- and post-tests; and (d) the reports on the samples' progress.

DATA COLLECTION

The exercises will be applied to the samples over a period of 4 weeks. In the first week, there would be a pre-test before implementing the exercises. The following 3 weeks will consist of a pre-test before the lesson and a post-test after the lesson. The tests will be recorded individually via video recording. The committee reviewing the tests comprises three parties: (a) the researcher, (b) a trombone instructor, and (c) a brass instructor. There are four processes for data collection as follows:

1. Before implementing the exercises, the researcher will do a pre-test on the samples. Allow samples to study the music piece for 10 minutes without playing. Afterwards, do the pre-test by using the skill assessment.
2. Implementing the exercises created by the researcher for 4 weeks.
3. The researcher will do the post-tests weekly, which are the same as the pre-test. The post-tests will be divided into two post-tests: the post-test taken after the lesson after giving time to the samples to practice the exercises (four times), and the post-test taken before the lesson serves to evaluate the efficacy of the exercises after using the exercises for 1 week (four times) in order to compare the scores of the pre- and post-tests, as well as the weekly post-tests to evaluate the progress of the sample.
4. Weekly reports by samples on progress and the frequency of practices between lessons.

DATA ANALYSIS

1. Analysis of the data collection, the pre-test, and the score came from the average scores of three committees. The scores obtained by students were analysed individually.
2. The post-tests, whose content is the same as the pre-test, were taken eight times once a week. The scores came from the average scores of three committees. The scores were analysed individually.
3. Analysis of the individual interviews comparing results after using the exercise for 10 minutes and for 1 week.
4. Analysis of the weekly reports recorded by the samples.
5. Analyse and compare progress during and after using the exercises for the samples individually using scores and reports from the samples.

RESULTS

This session of the article would discuss the overall results of this research, which include (a) the exercises created by the researcher to improve range connection by incorporating Thai vowels using bar 176-183 in the first movement of *T-Bone Concerto* by Johan de Meij as the study piece; (b) the skill assessment of the samples' improvement after implementing the exercises; and (c) the results of the samples' progress as measured by the assessment along with observations from the samples and the researcher.

THE EXERCISES FOR RANGE CONNECTION FOR TENOR TROMBONE BASED ON *T-BONE CONCERTO* BY JOHAN DE MEIJI

The key components in connecting ranges for the tenor trombone are air control and oral movement. The oral movement changes the shape and size of the oral cavity, which affects the quantity and character of the air. For example, playing low register requires big-sized oral cavity while playing high register requires a smaller size. The size of the oral cavity can be divided into five sizes that fit with five Thai vowels of long monophthongs: (a) $\text{ə̄}/ i:/$ E, (b) $\text{ɔ̄}/ \varepsilon:/$ A, (c) $\text{ə̄}/ a:/$ R, (d) $\text{ə̄}/ ɔ:/$ Or, and (e) $\text{ə̄}/ u:/$ Au. E is for high register. A is in between high and middle registers. R is for middle register. Or is in between middle to low register. Au is for low register. There are 14 exercises in total, which are divided into three parts for low, middle, and high registers. It is important to pay attention to slurs and tempo marks and to read the notes carefully.



Figure 2: Exercise 1. This is an exercise to show how the oral cavity should move.

Exercise 1 is to support movement of the oral cavity (Figure 2). Exercise 2 uses the glissando to feel the change. It slightly changes from note to note, transforming from one vowel to another. It contains room changing in between notes. Additionally, buzzing the mouthpiece with glissando from Bb 4 to F 2 is required and optional for lower notes. These two exercises set the concept of how to use vowels in high, middle, and low registers (Figure 3).



Figure 3: Exercise 2. To moving to connect all ranges.

The air speed is another key to connecting the ranges on the tenor trombone. From exercises 1 and 2, when the oral cavity changes, it also affects the air speed; however, it would be more efficient if the performer clearly knew how to change the air speed.

CONNECTING FROM MIDDLE TO LOW REGISTER

For connecting the middle to the low register, there are a few things that we need to consider how to use the air and the correct embouchure. From using the air speed from the middle to the low register, the first thing that needs to be considered is how to use the air. For using air speed in low register, the key is to use slow speed but with a lot of air. Imagine watching the tsunami from a bird's eye view. It moves slowly yet powerfully. That is the idea of how to use the air for the low register. The vowels for middle to low register are A, R, Or, and Au.

The second thing is the correct embouchure. Incorrect embouchure causes the sound at the beginning to have a slight adjustment. To make it clear, the slide up or down of the sound at the beginning of playing can be heard. This part of the exercises aims to check the embouchure and connect the middle to the low register.

For exercise 3, play while listening very carefully to the slide-up or slide-down sound. If that problem can be heard, the way to fix it is to adjust the setting before playing by making sure that it is locked in the correct setting before playing. Do not open too much or too little. The requirement for this exercise is for the first bar to be bar number 28; other than that is the extra part. At first, play as long as you can, and once you are comfortable with the duration, make it slightly shorter step by step. This will help increase precision. In bar 24, there is an optional B1. This is because the tenor trombone has no B1. The way to play this one note is to bend down the note to B1 in the seventh position with the valve or to tune the valve in E instead of F. This exercise is for checking and working on the precise embouchure so the B1 can be optional (see Figure 4).



Figure 4: Exercise 3. To check and help reach the correct embouchure.

The next step for connecting middle to low range is the air speed. Make sure to start slowly and listen carefully to avoid the slide-up or slide-down sound. The player should start with a slow tempo, a quarter note equal to 60 beats per minute to feel the air and do not forget that the key to playing low is the air speed, moving slowly with energy. When the player gets used to the air moving, speed the exercise up step by step until a half note equals 100 beats per minute. When playing fast, make sure it is slurred. For exercise 4, this will help the player feel the air from the middle to the low register. It is from faster air to slower air. Those exercises will help connect the middle to low registers on the tenor trombone. It helps with precision in the starting of playing and also feel the air from the middle to the low register. This is the requirement for the first bar to be bar 28. The rest of the bars are optional (Figure 5). Nevertheless, everyone should learn the reverse as well, which means connecting from the low range to the middle range. The next exercise is starting a note in low register. Make sure to use the Thai vowels from exercise 1 to help start the note in low register. Make sure it starts on time with no slide-up or slide-down sound.

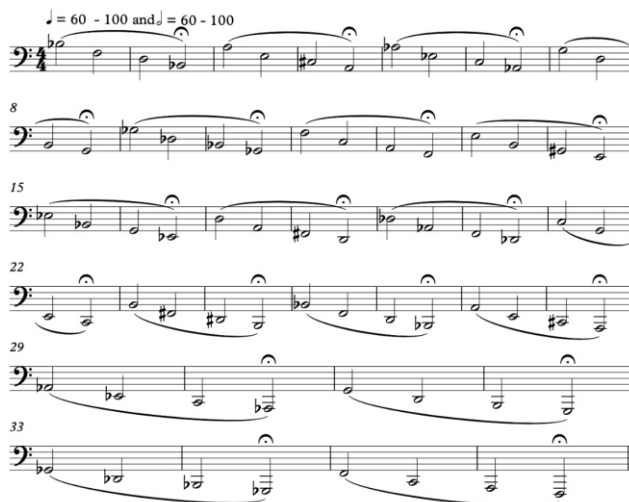


Figure 5: Exercise 4. Connecting the middle to low register.



Figure 6: Exercise 5. Starting low notes.

An important reminder for exercise 5 is to make sure to start playing on time, including playing on time with no slide-up or slide-down sound when it starts or changing the notes. Use the Thai vowels from exercise 1 to help start the note in low register. This is the requirement for the first bar to be bar 28. The rest of the bar is optional. At first, play as long as you can and make it slightly shorter step by step when feeling comfortable with this exercise. To play shorter, it will be more difficult because it requires more precision (Figure 6).

The next exercise is the reverse. It is connecting from the low to the middle register. This exercise teaches how to use the air speed from slower to faster. It may seem simple, but it is actually tricky to accomplish.



Figure 7: Exercise 6. Connecting the low to middle register.

Exercise 6 is connecting from low to middle register. The beginning is the most important spot that the samples must be aware of when practicing this exercise. The requirement is for the first bar to be bar 28. The rest of the bars are optional. This exercise is a study of how to use the air from a slower to a faster speed. Make sure it starts on time and practice slowly. Using the Thai vowels idea from exercise 1 will help with starting the first note of the phase and with the playing (Figure 7).

Exercises 3 to 6 are the studies of connecting ranges from middle to low register and reverse. It may seem simple, but it is not the same. So, make sure to listen carefully while playing. The idea of these exercises is to play the notes precisely without slide-up or slide-down sound, including knowing how to use the air speed and connecting between the middle and low registers.

CONNECTING FROM MIDDLE TO HIGH REGISTER

For connecting from the middle to the high register, there are several things that we need to consider. The key to playing high register is the air speed. So, from the middle to the high register, change the air speed from slower to faster, including changing the embouchure from wider to smaller. The vowels for middle to high are R, A, and E. Those vowels change the oral cavity. A smaller oral cavity helps the air move faster and more easily.

The key to these exercises for connecting the middle to the high register is that the air changing and embouchure changing must harmonise; otherwise, it will be cracked.



Figure 8: Exercise 7. To correct embouchure and air speed.

When playing this exercise, if you find out that you have any cracked note, then replay and fix it. When jumping the last interval of each group, it is the widest interval that reaches the highest note of each group. You may need to consider using the air speed more than you think in this part (Figure 8).



Figure 9. Exercise 8. Connecting the middle to high register.

Exercise 8 is connecting from the middle to the high register. To practice this exercise, play slowly at first and feel the preparing slightly before changing to another note. To feel the preparing means to feel how to play the next note, including the embouchure and the air speed before changing to the next note. Do not forget to use the air speed more than you think you need to in the last interval of each group (see Figure 9).

For connecting the middle to the high register, it is important to learn in reverse as well. It seems to be the same, but it is not. For example, starting the note in high register is not simple. It needs to be precise with the correct embouchure and air speed; otherwise, it will be cracked.

The next exercise covers how to start the notes in the high register. Make sure to use the vowel E when you start playing these groups.



Figure 10: Exercise 9. Starting with high notes.

For exercise 9, if you have difficulty starting the note, try to play it until you get the sound, and before starting again, imagine that you are playing the note exactly how you would really play it and start to play it. Repeat until you get used to it. This idea can be used for people who have cracks when starting to play as well. Additionally, you may need to think more about playing with faster air than you actually do at the beginning to play in high register. When you play the first interval, which is the widest interval, the air speed needs to be reduced a little bit, but not so much. When you are able to play this exercise, make sure to work on relaxation as well. The way to make it relaxing is to use the air more than the embouchure while playing. Do not forget that the key to playing high note is the air speed (Figure 10).

The next exercise is connecting the high to the middle register. There are two things you need to be very careful of. First, when you play in the first interval, which is the widest interval, the air speed needs to be reduced slightly, but not too much. Second, make sure the air speed supports all the notes when you play from high to middle register. For this exercise, the air speed will slow down and give more air volume (Figure 11).



Figure 11: Exercise 10. Connecting high to middle register.

To work on exercise 10, play slowly at first and feel the preparing slightly before changing the note to another note. Also, feel the air speed.

CONNECTING ALL REGISTERS

This section is a mix of all ranges in the tenor trombone, which includes low, middle, and high registers, while presenting a bigger challenge with changing the air and the oral cavity using Thai vowels. This section covers connecting all ranges from low to high and back to low register, as well as from high to low and back to high register. It also covers changing more movement on a wider interval by playing the root and fifth of the selected arpeggios.

Exercise 1 in this section starts with the low to high and back to low register. All the Thai vowels must be used: Au, Or, R, A, and E, and also in reverse with E, A, R, Or, and Au for going back to low register.



Figure 12: Exercise 11. Connecting the range from low to high and back to low register.

For exercise 11, make sure all the notes are centred and there is no sliding sound when playing in the low register. For high range, make sure there is no cracked note and play each phase in one breath. If you cannot play in one breath, take a breath and repeat the note before taking another breath. Do not break the exercise in octave by breathing. This requirement is for bars 1 to 15. The rest of the bar is optional (Figure 12).

The next exercise covers connecting all ranges from high to low and back to high register. All the Thai vowels are used, starting with E, A, R, Or, and Au. It also requires the reverse, which means Au, Or, R, A, and E on the way back up to high register.

Figure 13: Exercise 12. Connecting the range from high to low and back to high register.

From exercise 12, make sure there is no crack when starting a note or playing in the high register and no sliding sound in the low register, including playing every note in the centre. Play each phase in one breath. If you cannot play in one breath, take a breath and repeat the note before. Do not break the exercise in octave by breathing (see Figure 13).

The last two exercises are created for wider intervals and play only the root and fifth of the selected arpeggios. It requires a bigger change, starting from high to low and back to high, and then from low to high and back to low.

Figure 14: Exercise 13. Connecting the range from high to low and back to high register for only the root and fifth.

Figure 15: Exercise 14. Connecting the range from low to high and back to low register for only the root and fifth.

For exercises 13 and 14, the requirements are the same, for bars 1 to 10. The rest of the bar is optional. Make sure there is no cracked note when starting or playing high register and no sliding sound in low register. Play every note in the centre. If you cannot play the phase in one breath, you can take a breath and repeat the note before. Do not break the exercise in octave by breathing. For exercises 11–14, make sure to use all the key concepts from previous exercises as well (see Figures 14 and 15).

SKILL ASSESSMENT

The skill assessment is divided into six categories: (a) phrasing, (b) control in low range, (c) control in middle range, (d) control in high range, (e) control in range connection, and (f) improvement with scores ranging from five to one for each category. The skill assessment, as shown in Table 1, is used for both pre- and post-tests of samples using the rubric score system.

Phrasing	5 Play the whole phrase nicely and smoothly in every phrase	4 Play the phrase smoothly with one mistake	3 Play the phrase with small troubles with two mistakes	2 Play the phrase with some troubles (not playing smoothly/unable to reach some phrases in one breath/able to reach with three mistakes)	1 Unable to reach and play any of the phrases in one breath
Control in low range (all notes below Bb2)	5 Good sound. Precise. No sliding from the embouchure	4 Good sound with one to two mistakes	3 Three to four mistakes	2 Five to six mistakes	1 Seven or more mistakes
Control in middle range (from Bb2 to E4)	5 Good sound No mistake	4 One to three mistakes	3 Four to six mistakes	2 Seven to nine mistakes	1 Ten mistakes or more
Control in high range (all notes above E4)	5 Good sound No crack	4 one to two mistakes	3 Three to four mistakes	2 Five to six mistakes	1 Seven mistakes or more
Control in range connection	5 Change ranges well	4 One to two mistakes with correct process	3 Three to four mistakes with adequate process	2 Five to six mistakes with bad process	1 Seven mistakes or more with wrong process
Improvement	5 Obvious and rapid	4 Good with good pace	3 Fairly noticeable	2 Barely noticeable	1 None

Figure 16: The skill assessment criteria.

The exercises consist of five topics: (a) phrasing that uses oral movement and air speed; (b) control in low range; (c) control in middle range; (d) control in high range; and (e) control and connecting all ranges. The samples are seven Thai undergraduate trombone students from three universities in Bangkok, Thailand. Tests are used to measure samples' improvement and determine the samples' progress along with observation. The pre-test was taken once in the first week. Afterwards, the researcher gave each sample online private lessons via Zoom application for 1 hour per week for 4 weeks. The post-tests were taken eight times in total, twice each week, before the lesson to measure improvements in the samples' practice in-between and after the lesson. The tests use a metronome and a quarter note – 63 without ornament notes except for the final test. The researcher required the samples to be able to perform rubato, rallentando molto, and ornament notes at the end of the experiment. The tests were then given to the committee for grading.

The comparison between the pre-test in the first week and the final post-test in the last week shows that all samples have improved in all topics concerning range connection and control (see Table 2). Table 3 shows comparisons between total scores from the pre-test and from the last post-test (see Table 3). The full score is 25 with score differences ranging from 3 to 16 points. This shows that the results of all samples improve after using the range connection exercise. Although samples are from different levels of background experience in trombone, all have improved. The exercises prove to be helpful to every sample at all levels. The use of Thai vowels in the exercises helps samples understand trombone techniques better, resulting in improvement.

Topic	Pre-test score obtained by individual student							Post-test score obtained by individual student						
	S1	S2	S3	S4	S5	S6	S7	S1	S2	S3	S4	S5	S6	S7
Phrasing	4	3	2	5	2	3	1	5	5	5	5	5	5	5
Control in low range	3	2	3	4	5	4	1	5	5	5	5	5	5	4
Control in middle range	4	2	1	4	4	4	1	5	5	4	4	4	4	4
Control in high range	2	3	2	4	2	3	2	5	4	5	5	5	5	4
Control and connecting all ranges	3	2	3	4	3	3	1	5	5	5	5	5	4	5

Figure 17: Comparison between pre-test and final post-test scores of all samples.

Sample	Pre-test	Post-test	Score differences
Sample 1	16	25	9
Sample 2	12	24	12
Sample 3	11	24	13
Sample 4	21	24	3
Sample 5	16	24	8
Sample 6	17	23	6
Sample 7	6	22	16

Figure 18: Total scores of each sample's pre-test and final post-test scores comparison.

Sample 1 improved in connecting all ranges with more centred sound, less crack, and less tension. Exercises 1 and 2 helped the sample learn and better understand the changes in the oral cavity and air speed by using Thai vowels. The sample needed some time to remember the vowels used in those ranges, but once it succeeded, the sample improved greatly at a good pace each week.

For sample 2, the exercises helped the sample improve in connecting all ranges, making the playing easier using Thai vowels and the air speed to find the sound centre easier. The exercises helped the sample connect all ranges and improve the sound quality as well. Prior to the exercises, the sample had difficulties playing the high range, but now the sample is able to play with more ease with a clear understanding of the use of air speed.

For sample 3, exercises 3–6 helped the sample to better control the low range. Since post-test 2.2, the sample got a full score of controlling in low range, while the connecting middle to low range exercise also helped the sample play in high register with more ease. The air speed and vowels help the sample improve in all ranges. Overall, the improvement of the sample was at a good pace.

For sample 4, the sample is talented with its own playing style and a high pre-test score. The sample needed time to adjust the style of playing. Once the sample got used to the Thai vowels, which allowed the player to better understand range connections, the scores continued to improve.

For sample 5, the exercises improved tone quality, flexibility, and air connection and helped the sample play with more ease. The sample achieved better air flow, allowing it to play more slur with more ease and a more controlled dynamic. In the fourth week, the sample had the opportunity to play Schumann's *Symphony No. 3*, which requires much flexibility and flow. The sample felt that the exercises helped the sample to play with more ease.

For sample 6, Thai vowels and air speed direction in exercises 1 and 2 help the sample to correct the playing faster when mistakes are made. The Thai vowels and the air speed direction in exercises 1 and 2 helped the sample to get back on track quickly when lost. The sample improved in flexibility, flow, and precision in all ranges.

Sample 7 improved greatly at a slow and steady pace. The sample first found Thai vowels confusing, but after weeks of daily practice, the sample was able to play with more ease, with improved sound, especially in middle

range, and with more quality in the low range, in which the sample used to struggle. The sample noted that the exercises provided fundamental practices, which greatly improved the player's skill. The sample intends to practice these fundamentals prior to practicing pieces in the future.

In summary, the exercises appear to help with both range connection and tone quality of the tenor trombone when combined with the Thai vowel use. Exercises 11–14 seem to improve the samples' flexibility, greatly allowing the samples to play more smoothly with fewer cracked notes. The performance in high and low registers becomes stronger and easier. The samples gained a better understanding of the use of air speed for each range, allowing them to play with better flow and with less tension. The use of *arpeggio* in the exercises also helped the samples to play more in tune. Although the concept of using Thai vowels in trombone studies was foreign to the samples at first and required a certain amount of time to get used to the idea, the range connection exercises with Thai vowels have proven to be efficient and truly improve the sample's ability in range control and connection significantly.

LIMITATIONS AND SUGGESTIONS

With the COVID-19 pandemic, this experiment comes with its own limitations in terms of the accessibility of samples and the restriction of online lessons. For the issue of accessibility, some universities in Thailand have no trombone students, and some of those who do have no tenor trombone with F-attachment, which is a vital component since it renders the player, especially an inexperienced one, to achieve a wider range. This results in a few available samples for this study. Additionally, the pandemic limited the lessons to online platforms where Internet connection affected the lessons and the samples' performances. Though the online lessons offered flexibility in terms of time and location, an unstable Internet connection might disrupt the lessons. This is solved by having the samples submit a record of their performances to avoid any disruption. Despite these limitations, the success of the experiment proves that these exercises are effective in improving range control and connection skills. For further study, it is recommended to increase the number of samples and expand data collection to samples from other countries in order to gain more diverse results.

APPLICATIONS

The exercises have proven to be effective for trombone students at the undergraduate level and, with additional modification, are applicable to trombone students of all background and levels of advancement. For the professional level, the tempo in exercises 11–14 may be increased to create more challenges and allow players more flexibility. The middle- to low-range exercises can also be used as warming-down. For the undergraduate level, the exercises can be used as is to help improve precision. For high school level, exercises 11–14 may need to be modified to have less difficulty. The exercises would help the players with range connection and intonation for ear training with *arpeggio*. For beginners, Thai vowels will allow the player to get the correct note faster with correct oral movement.

CONCLUSION

The set of exercises created consists of 14 exercises that focus on oral movement and connection between all three registers, low, medium, and high, to enable the players to connect all registers in one breath. This research shows that the use of Thai vowels as a tool to teach air speed control and oral movement to improve skills in range control and connection in tenor trombone students at the undergraduate level proves to be efficient and successful. Furthermore, it opens possibilities for further study with different factors, such as a larger number of samples, different pieces of music, and the use of vowels of different languages, which may lead to different results. The level of difficulty in each exercise can also be modified to suit trombone students and trombonists of different levels. Furthermore, this concept of Thai vowels can also be adapted to different brass instruments that use the same system of playing. In conclusion, the range connection exercises developed for tenor trombone are useful not only for undergraduate trombone students but also for all levels of trombonists, including beginners, high school students, and professionals.

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