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# A CORRELATION BETWEEN THAI TONE PERCEPTION AND WRITING SKILL IN LEARNERS USING THE "THAI TON APPLICATION"

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## ABSTRACT

The use of education applications in language learning is rapidly growing. This research aims to analyze the relationship between the tonal perception ability and writing ability of low Thai language proficiency students using the Thai Tone Application. The study participants were 100 Chinese students studying Thai language in Rajabhat Nakhon Ratchasrima Thailand and in Kaohsiung University in Taiwan. The participants were divided equally into two groups: 50 students were placed in the experimental group (Group 1) who studied in class using the application and 50 students were placed in the control group (Group 2) who studied in class without using the application. One-syllable words were used to examine the participants' tonal perception and writing skill. The findings showed a positive moderate correlation between tonal perception and writing skill after using the application in the experimental group. In contrast, the correlation between tonal perception and writing skill in the control group who learned without using the application was negative, indicating that having good tonal perception did result in a moderate writing skill level. The results of the present study further indicate that instructors play a significant role in students' language learning and that use of the application as a supplemental material may enhance learning outcomes. The significance of minimal pair approach is also discussed.

**Keywords:** Tones, Thai, Perception, Application

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## Background and study rationale

Linguists have discovered that there is a correlation between perception and sound production. Perception refers to the process of sensory perception by the ears to sounds uttered by speakers. Sound production refers to the process of vocal production, writing, and reading. Several studies have shown that language learning through the process of effective perception yields effective language production. In other words, the practice of sound perception is crucial and can lead to the development of other skills (Keys & Walker, 2002; Levis, 2005; Lowenberg, 2002; McArthur, 2001; Shanahan, 2006).

For English language learners specifically, research suggests that English sound perception affects the learning of other English skills (Bergman, 1999; Berninger, 2000; Bozorgian, 2012). A study on foreign language learners by Bozorgian (2012) concluded that English perception skill correlates moderately with writing skill and highly with reading skill. Similarly, research conducted by Aoyama et al. (2004) has shown that Japanese learners studying English as a foreign language had good Japanese language perception in addition to good English speaking skills. A similar study conducted with Chinese learners yielded the same result (Jia et al., 2006).

Research has demonstrated a correlation between perception and sound production only at a moderate level (Flege et al., 1997; Hattori & Iverson, 2010; Sakai & Moorman, 2017; Schmidt & Flege, 1995). Similarly, Hattori & Iverson (2009) suggest that Japanese speakers' perception of sound /r/, /l/ is correlated with the ability to differentiate the /r/, /l/ in the Japanese language, though the very same perception correlates with production of /r/, /l/ sounds in English at a moderate level only. A study on learning Korean as a foreign language also yielded the same result (Kim & Park, 1995).

Language production involves sound uttering, speaking skill, and writing skill (Bozordian, 2012). Several researchers have shown that perception not only correlates with speaking skill, but also with writing skill; for instance, the analysis of Thai tones produced by participants learning Thai as a foreign language found that the unclear perception of Thai tones could lead to ineffective writing skill, particularly the use of the wrong tone symbols (Puttamata, 2011; Sathiansukon, 2010; Srisunthornthai, 2013). Such findings have led to the development of pronunciation practice materials (Chichareon, 2011), in which linguists stress the importance of tone study, because different tones differentiate the meaning of words. Yip (2002) states that tone is a pitch that differentiates word meaning.

However, studies examining the relationship between tone perceptions and writing skill are not as common as studies on perception and pronunciation skill. This study, therefore, aims to investigate whether a correlation exists between Thai tone perception and writing skill. In this research, Thai tones perceived and produced by Chinese students with a low proficiency in Thai aged of 15–22 years were studied as Buranasinvattanakul (2018) found that Thai language continues to gain popularity worldwide. In addition, prior research on this subject has focused on the analysis of Thai tones produced by language learners, without applying technology (e.g., e-books and applications). Applying technology to improve learning is a policy that has been implemented by the Ministry of Education in Thailand. Groups of linguists have developed technology to serve the aforementioned policy and help learners practice their pronunciation and perception of Thai tones. Examples of these technologies include a Thai tone

pronunciation practice book developed by Chichareon (2011) and Matsumoto (2011); the Read and Write Thai program by Tumtavitikul (2013a); the Thai speech Tablet, which is a Thai tone pronunciation application developed by Tumtavitikul (2013b); e-lessons by Luangthongkum (2015); and a Thai tone mobile application by Teeranon (2015). These technologies have been created on the basis of research into Thai tones.

In addition, linguists and speech therapists have introduced the "minimal pair approach" to the clinical practice of speech sounds in children. Dodd et al. (2008, p.339) mentioned to minimal pairs contrasts as:

> *"The word pairs differed by one sound in either voice, place or manner. The word pairs typically contrasted the child's target and error sound. For example, if the target error pattern was velar fronting the minimal phoneme contrast pairs would include car – tar, key –tea. For clusters, the error form was always compared with the target. For example, contrasts for /s/ deletes in sp- clusters were: top – stop, pin – spin. A range of clusters could be targeted for any child within their phonological pattern (e.g., s p stop could include /sp, st, sk/ target words)."*

Minimal pairs are a formal component of Phonology. Phonemic contrast is essential and effective in various clinical tests (Barlow & Gierut, 2002; Dodd et al., 2008) and producing a range of possible and suitable speech therapies for children. Most of the speech therapy research using the minimal pair approach focuses on contrastive speech segments (Best, 2019; So & Best, 2014) such as pin-bin, bin-bun, etc, though this approach has not yet been widely included in any suprasegmental levels such as Thai tones or in any language applications that teach Thai tones.

The Thai Tone Application applies the minimal pair approach to its content; there are tone minimal pairs, such as [phaan]+mid "tray"- [phaan]+low tone "to pass", and [naa]+high tone "aunt" - [naa]+rising tone "thick". Therefore, the question studied by this research paper is whether the integration of the minimal pair approach in the application leads to better perception skill and results in better writing skill (production). The results shed light on the theory that the better the speech perception, the better the speech production (Simser, 1993). The results of this study also attest to the benefits of the minimal pair approach to Thai tones, which is widely used in speech therapy.

The main purpose of this study is to analyze the correlation between Thai tone perception and the written spelling ability of Chinese students aged between 15–22 years with a low proficiency in Thai after using the Thai Tone Application. The participants were grouped into an experimental group and a control group. The experimental group studied in the classroom using the application, while the control group studied in the classroom but did not use the application. The analysis compared tone perception and written spelling (one syllable) of the two groups to test the hypothesis that good perception is correlated with written spelling at various levels.

## Objectives of the research

1. To compare the difference between Thai tone perception among Chinese students aged 15–22 years before and after using the Thai Tone Application

2. To compare the difference between participants' written spelling of Thai words before and after using the Thai Tone Application in a classroom setting

3. To analyze the relationship between participants' Thai tone perception and writing skill after using the Thai Tone Application

## Research Methodology

The research methodology involved determining the setting, dividing the study participants into groups, developing an analysis framework, and presenting the research results. The details of these steps were as follows:

### Research Framework

*Setting:*

The study was conducted with 2 main participants: 100 Chinese students in Rajabhat Nakhon Ratchasrima Thailand and in Kaohsiung University, Taiwan. Chinese students aged 15–22 years were divided into 50 students studying Thai language at Rajabhat Nakhon Ratchasrima (Korat) and 50 students in Kaohsiung University. The participants from the 2 universities were asked to take Standard Thai proficiency test of Sirindhorn Thai Language Institute, Chulalongkorn University, Thailand. All participants were classified in the low proficiency in Thai language because the Standard test contains creative writing part.

*Participants:*

All selected participants were not disabled and had complete pronunciation organs, such as the tongue, teeth, mouth, and pharynx. Using a purposive sampling technique, 100 students aged between 15–22 years were selected as the study participants.

The participants were divided into 2 groups: there were 50 students in the experimental group (Group 1) who studied in class using the Thai Tone Application and 50 students in the control group (Group 2) who studied in class without using the Thai Tone Application.

*Research Procedure:*

The class hours in Rajabhat Nakhon Ratchasrima Thailand and in Kaohsiung University are designed and taught according to each university regulation and plan. Number of class hours are identical, 50 minutes. Group 1 is different from Group 2 in that learners of Group 1 were asked to practice Thai tones through the Thai Tone Application for 30 minutes.

Regarding the Thai Tone Application, it is the application licensed and content created by Faculty of Liberal Arts in collaboration with Faculty of Information and Communication Technology of the University of Phayao. The application contains lesson and game based on the previous research results (Teeranon, 2015) with scores.

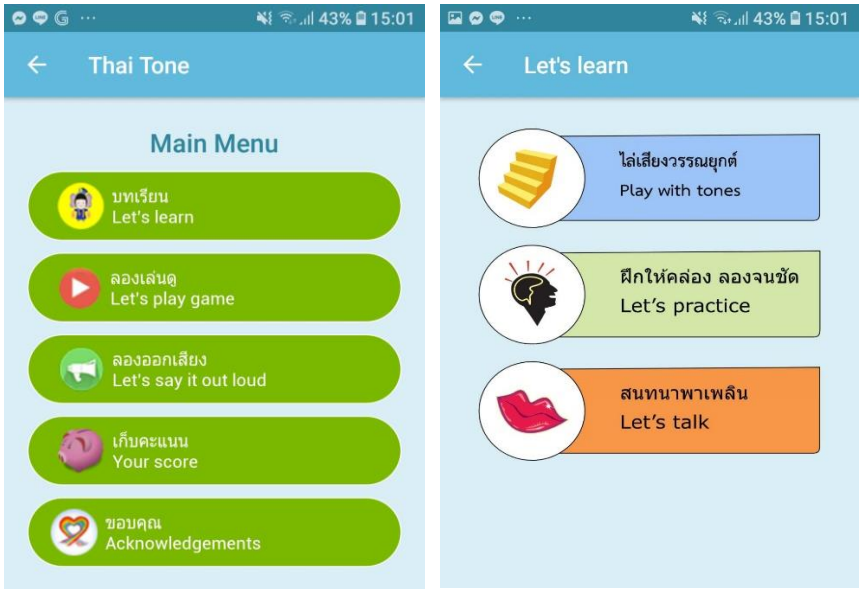


**Figure A.** The Thai Tone Application Interface

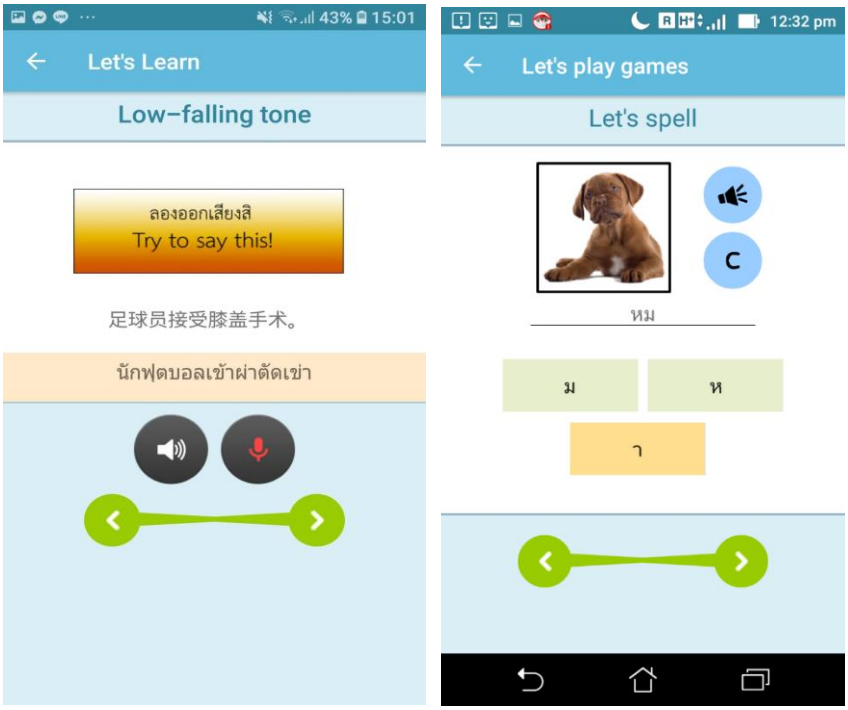


**Figure B.** An example of Thai tone minimal pairs (Low-Falling) in the Application

1) The Thai Tone Application was modified to contain 100 one-syllable words and more than 60 minimal pairs of Thai tones (See Figure B.). The application contained both pictures and sounds. Each image was described by a one-syllable word underneath it. Pictures were also used to illustrate the meaning of each sentence. Students were able to press a button to listen to sounds and practice their pronunciation with a live correction.

2) The application used by the experimental group contained one more feature consistent with the minimal pair approach. For example, the application contained the following sentence:

*[khaaŋ]+falling [naa]+falling [thi]+falling* ***[naa]+mid*** *[pluuk]+low [nɔi]+high.****[naa]+low*** *[wai]+high [maak]+falling [maai]+mid*

*There are plenty of custard apples planted in front of the rice field.*

This helped in the pronunciation of the first or flat tone of the word [naa]+mid "rice field" "rice field" and the second or down tone of the word [([nɔi]+high).[naa]+low "custard apple".

This kind of practice is known as the minimal pair approach in the clinical treatment. The approach has long been claimed to promote speech development in low proficiency children (e.g., children with speech disorders) and help acquire the target language faster (Elbert et al., 1984; Saben & Ingham, 1991).

3) Twenty-two words were prepared for a listening test. The 22 words were one-syllable words grouped into sets of tonal sounds containing both live syllables and checked syllables, as shown in Table 1.

**Table 1** Thai word for recording

| **Mid** | **Low** | **Falling** | **High** | **Rising** |
|---|---|---|---|---|
| [khaa] "to be stuck" | [khaa] "galangal" | [khaa] "value" | [khaa] "to trade" | [khaa] leg" |
| [naa]"rice field" | [([nɔi]+high).[naa] "custard apple" | [naa] "face" | [naa]"aunt" | [naa] "thick" |
| | [faak] "on the other side" | [faat] "to hit" | | |
| | [khaat] "to be torn" | [khaat] "to wear a headband" | | |
| | [khap] "to drive" | | [khap] "tight" | |
| | [lak] "main pillar" | | [lak] "to steal" | |
| | [nak] "heavy" | | [nap] "to count" | |
| | [fak] "pod" | | [fak] "winter melon" | |

A Thai native speaker was asked to pronounce the 22 words, which were recorded with a SONY IBC BX140. The participants listened to the recorded pronunciations and then pronounced the 22 words.

Both the control and experimental groups were tested on their tone perception (Pre-test) prior to using the application. The pre-test was comprised of 18 items, each with two choices.

In item 1, the student heard [naa] “face” and was provided with the following two choices:

a. 

b. 

The participants were separated into two groups. The experimental group attended class regularly and practiced Thai tonal sounds using the application for five weeks. Each day, the experimental group participants studied using the application for 30 minutes. The process was conducted according to research-based learning (Phiboon, 2016). The control group also attended class regularly, as with the experimental group, though they did not use the application.

6) After five weeks, the experimental group listened to tonal sounds that were identical to the sounds they had practiced using the application, while the control group listened to sounds that were identical to the sounds they had practiced in class.

7) For testing sound perception, the participants listened to the 22 tonal words and completed the tonal listening test. In the test, the participants chose the tonal sounds they heard according to the examples shown. Each item contained choices with pictures representing sounds; for example, when listening to the sound [naa] “face”, the choices presented included pictures of a rice field and a face. Using the pictures as choices in the listening test confirmed listeners’ understanding of the true meaning of the sounds without any influence of pictures and sounds.

8) In analyzing the spelling of written words, both groups of participants listened to the 22 test words and wrote down the words they heard on the answer sheet. The participants’ writing skill was then determined based on these answers by the researcher. Points were awarded for the correct spelling of words, including both consonants and vowels.

9) The results of the experimental and control groups were compared based on their tonal perception and writing skill in accordance with the research objectives.

10) Comparisons of the differences between before and after using the application and following in class learning were analyzed. The statistical analyses included descriptive statistics (mean and percentage), a t-test, and a correlation between tonal perception scores and writing scores with a Bartz (1999:184) correlation level.

**Table 2** Correlation level

| **Correlation** (r) | **Level of correlation** |
|---|---|
| 0.81 – 1.00 | the highest |
| 0.61 – 0.80 | high |
| 0.41 – 0.60 | moderate |
| 0.21 – 0.40 | low |
| 0.00 – 0.20 | the lowest |

## Results

This research sought to compare the difference between Thai tone perception before and after using the Thai Tone Application in a classroom setting among Chinese students aged 15–22 years with a low proficiency in Thai. Specifically, the difference between the written spelling of Thai words produced by participants before and after using the application in class was examined to ascertain the relationship between Thai tone perception and written spelling ability after using the Thai Tone Application.

Participants used the application during class for five weeks, and the results were as follows:

### 1. Analysis of Thai tone perception after using the Thai Tone Application

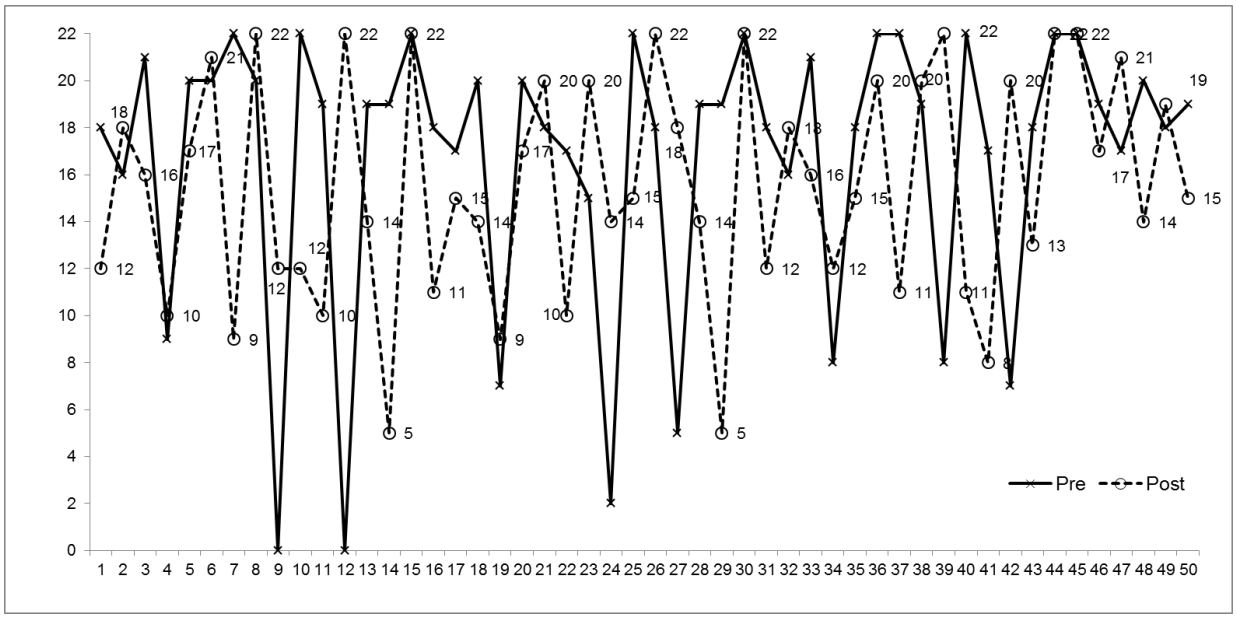


**Figure 1** The difference in Thai tone perception of the experimental group (App.) before and after using Thai Tone Application and the control group before and after in-class learning (Non-App.)

Data shown in Figure 1 and Table 2 indicate that the experimental group that used the application had improved sound perception after using the application. The results showed that 17 participants increased their scores, 17 had decreased scores, and the scores of 16 remained the same. Two participants raised their tonal perception score by more than 50%. Among the control group, improvements in tonal perception were less than in the experimental group, at 5–14%. The result showed that the scores of 11 participants increased, while the scores of 18 participants decreased.

**Table 3** Differences between the Thai tonal perception of the experimental and control groups

| | **Experimental group App.** | | **% of change** | **Control group Non-App.** | | **% of change** |
|---|---|---|---|---|---|---|
| **Students** | **Pre** | **Post** | | **Pre** | **Post** | |
| 1 | 18 | 12 | -27% | 18 | 7 | -50% |
| 2 | 16 | 18 | **9%** | 21 | 14 | -32% |
| 3 | 21 | 16 | -23% | 20 | 22 | **9%** |
| 4 | 9 | 10 | **5%** | 13 | 9 | -18% |
| 5 | 20 | 17 | -14% | 19 | 13 | -27% |
| 6 | 20 | 21 | **5%** | 12 | 14 | **9%** |
| 7 | 22 | 9 | -59% | 21 | 11 | -45% |
| 8 | 20 | 22 | **9%** | 16 | 6 | -45% |
| 9 | 0 | 12 | **55%** | 6 | 8 | **9%** |
| 10 | 22 | 12 | -45% | 20 | 3 | -77% |
| 11 | 19 | 10 | -41% | 10 | 13 | **14%** |
| 12 | 0 | 22 | **100%** | 21 | 9 | -55% |
| 13 | 19 | 14 | -23% | 20 | 15 | -23% |
| 14 | 19 | 5 | -64% | 18 | 14 | -18% |
| 15 | 22 | 22 | 0% | 18 | 14 | -18% |
| 16 | 18 | 11 | -32% | 15 | 4 | -50% |
| 17 | 17 | 15 | -9% | 10 | 3 | -32% |
| 18 | 20 | 14 | -27% | 18 | 20 | **9%** |
| 19 | 7 | 9 | **9%** | 12 | 8 | -18% |
| 20 | 20 | 17 | -14% | 20 | 14 | -27% |
| 21 | 18 | 20 | **9%** | 10 | 13 | **14%** |
| 22 | 17 | 10 | -32% | 22 | 12 | -45% |
| 23 | 15 | 20 | 0% | 17 | 7 | **9%** |
| 24 | 2 | 14 | **5%** | 5 | 8 | 0% |
| 25 | 22 | 15 | -18% | 21 | 2 | -5% |

| | Experimental group App. | | % of change | Control group Non-App. | | % of change |
|---|---|---|---|---|---|---|
| **Students** | **Pre** | **Post** | | **Pre** | **Post** | |
| 26 | 18 | 22 | **27%** | 10 | 14 | 0% |
| 27 | 5 | 18 | 0% | 22 | 8 | 0% |
| 28 | 19 | 14 | **5%** | 20 | 17 | 0% |
| 29 | 19 | 5 | -9% | 19 | 12 | 0% |
| 30 | 22 | 22 | **5%** | 15 | 13 | 0% |
| 31 | 18 | 12 | 0% | 11 | 14 | -9% |
| 32 | 16 | 18 | 0% | 17 | 15 | **5%** |
| 33 | 21 | 16 | 0% | 7 | 11 | 0% |
| 34 | 8 | 12 | 0% | 5 | 10 | 0% |
| 35 | 18 | 15 | 0% | 8 | 5 | 0% |
| 36 | 22 | 20 | 0% | 9 | 19 | 0% |
| 37 | 22 | 11 | 0% | 13 | 15 | 0% |
| 38 | 19 | 20 | 0% | 17 | 21 | **9%** |
| 39 | 8 | 22 | 0% | 20 | 22 | 0% |
| 40 | 22 | 11 | 0% | 19 | 13 | 0% |
| 41 | 17 | 8 | -5% | 16 | 14 | 0% |
| 42 | 7 | 20 | 0% | 13 | 15 | **5%** |
| 43 | 18 | 13 | -13% | 17 | 16 | 0% |
| 44 | 22 | 22 | **5%** | 11 | 8 | 0% |
| 45 | 22 | 22 | 0% | 15 | 20 | 0% |
| 46 | 19 | 17 | **5%** | 15 | 4 | 0% |
| 47 | 17 | 21 | **5%** | 14 | 7 | 0% |
| 48 | 20 | 14 | **5%** | 13 | 7 | **9%** |
| 49 | 18 | 19 | **5%** | 11 | 5 | 0% |
| 50 | 19 | 15 | 0% | 10 | 5 | 0% |

**2. Analysis of writing skill after using the Thai Tone Application**

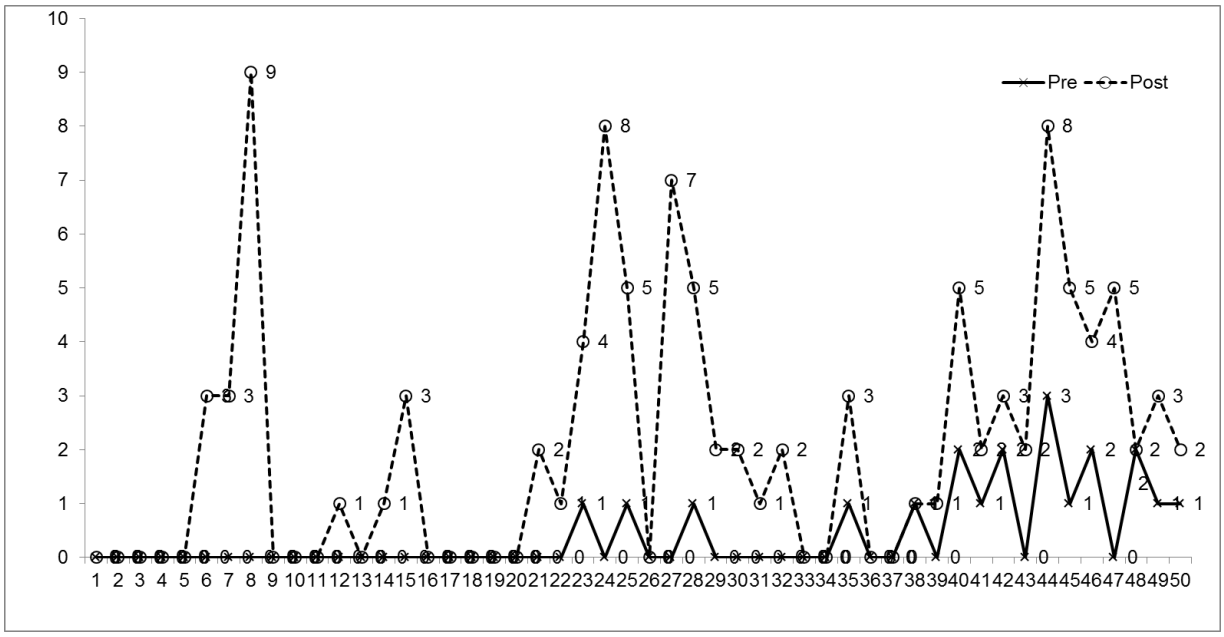


**Figure 2** The difference between the spelling of Thai words by the experimental group (App.) before and after using the Thai Tone Application and by the control group before and after in-class learning (Non-App.)

The results shown in Figure 2 and Table 3 indicate that the experimental group improved their writing skill after using the application by 5–68%. The result showed that the scores of 36 participants improved, while the scores of two participants decreased. The writing skill of the control group improved less than the experimental group, at 5–32%. In the control group, 19 participants increased their scores, while the scores of five participants decreased.

**Table 4** Differences in the written spelling of words among the two groups

| | **Experimental group App.** | | **% of change** | **Control group Non-App.** | | **% of change** |
|---|---|---|---|---|---|---|
| **Students** | **Pre** | **Post** | | **Pre** | **Post** | |
| 1 | 0 | 0 | 0% | 0 | 0 | 0% |
| 2 | 0 | 0 | 0% | 0 | 0 | 0% |
| 3 | 0 | 1 | **5%** | 0 | 0 | 0% |
| 4 | 0 | 5 | **23%** | 0 | 0 | 0% |
| 5 | 0 | 4 | **18%** | 0 | 0 | 0% |
| 6 | 0 | 10 | **45%** | 0 | 3 | **14%** |
| 7 | 0 | 0 | 0% | 0 | 3 | **14%** |
| 8 | 0 | 15 | **68%** | 0 | 9 | **41%** |

| | Experimental group App. | | % of change | Control group Non-App. | | % of change |
|---|---|---|---|---|---|---|
| **Students** | **Pre** | **Post** | | **Pre** | **Post** | |
| 9 | 0 | 2 | **9%** | 0 | 0 | 0% |
| 10 | 0 | 0 | 0% | 0 | 0 | 0% |
| 11 | 0 | 2 | **9%** | 0 | 0 | 0% |
| 12 | 0 | 12 | **55%** | 0 | 1 | **5%** |
| 13 | 0 | 2 | **9%** | 0 | 0 | 0% |
| 14 | 0 | 0 | 0% | 0 | 1 | **5%** |
| 15 | 14 | 15 | **5%** | 0 | 3 | **14%** |
| 16 | 0 | 3 | **14%** | 0 | 0 | 0% |
| 17 | 1 | 3 | **9%** | 0 | 0 | 0% |
| 18 | 0 | 0 | 0% | 0 | 0 | 0% |
| 19 | 2 | 3 | **5%** | 0 | 0 | 0% |
| 20 | 2 | 4 | **9%** | 0 | 0 | 0% |
| 21 | 1 | 2 | **5%** | 0 | 2 | **9%** |
| 22 | 2 | 5 | **14%** | 0 | 1 | **5%** |
| 23 | 0 | 2 | 0% | 1 | 4 | -63% |
| 24 | 0 | 1 | **9%** | 0 | 8 | 0% |
| 25 | 0 | 0 | **18%** | 1 | 5 | **5%** |
| 26 | 0 | 13 | 0% | 0 | 0 | **27%** |
| 27 | 0 | 9 | **14%** | 0 | 7 | **23%** |
| 28 | 2 | 4 | **18%** | 1 | 5 | **32%** |
| 29 | 3 | 5 | **23%** | 0 | 2 | -9% |
| 30 | 0 | 2 | **14%** | 0 | 2 | -5% |
| 31 | 0 | 8 | **5%** | 0 | 1 | **9%** |
| 32 | 1 | 5 | **5%** | 0 | 2 | **14%** |
| 33 | 2 | 5 | **36%** | 0 | 0 | **14%** |
| 34 | 0 | 1 | **14%** | 0 | 0 | **9%** |
| 35 | 0 | 5 | **5%** | 1 | 3 | **9%** |
| 36 | 1 | 7 | **9%** | 0 | 0 | -14% |
| 37 | 0 | 0 | **5%** | 0 | 0 | **14%** |
| 38 | 0 | 3 | **5%** | 1 | 1 | -5% |
| 39 | 2 | 3 | 0% | 0 | 1 | 0% |
| 40 | 1 | 2 | -14% | 2 | 5 | **5%** |

| | Experimental group App. | | % of change | Control group Non-App. | | % of change |
|---|---|---|---|---|---|---|
| Students | Pre | Post | | Pre | Post | |
| 41 | 0 | 1 | **5%** | 1 | 2 | 0% |
| 42 | 1 | 1 | **27%** | 2 | 3 | 0% |
| 43 | 0 | 1 | -5% | 0 | 2 | 0 |
| 44 | 0 | 2 | **5%** | 3 | 8 | 0% |
| 45 | 1 | 10 | 0% | 1 | 5 | 0% |
| 46 | 1 | 1 | **5%** | 2 | 4 | 0% |
| 47 | 2 | 3 | **5%** | 0 | 5 | 0% |
| 48 | 0 | 1 | **5%** | 2 | 2 | **9%** |
| 49 | 2 | 2 | **5%** | 1 | 3 | 0% |
| 50 | 0 | 1 | 0% | 1 | 2 | 0% |

**3. Relationship between Thai tone perception and writing skill**

**Table 4** The pre- and post-test scores in tonal perception and writing skill of the two groups

| Students | Skill | Scores | Mean | Differences (Post-Pretest) | | t-test | Sig.(2-tail) | Meaning |
|---|---|---|---|---|---|---|---|---|
| | | | | Mean | SD. | | | |
| **Experimental group App.** | Perception | Pre-test | 16.78 | -1.26 | 1.08 | -1.166 | 0.249 | No difference |
| | | Post-test | 15.52 | | | | | |
| | Writing | Pre-test | 0.82 | 2.90 | 0.52 | 5.628* | < 0.001 | higher |
| | | Post-test | 3.72 | | | | | |
| **Control group Non-App.** | Perception | Pre-test | 15.00 | -3.54 | 0.89 | -4.001* | < 0.001 | lower |
| | | Post-test | 11.46 | | | | | |
| | Writing | Pre-test | 0.40 | 1.70 | 0.31 | 5.518* | < 0.001 | higher |
| | | Post-test | 2.10 | | | | | |

* Sig at 0.05 level

| Group | Experimental group | Control group | Sig. | Scores difference | SD. | Meaning |
|---|---|---|---|---|---|---|
| Pre-test | 16.78 | 15.00 | 1.167 | 1.78 | 1.08 | No difference |
| Post-test | 15.52 | 11.46 | < 0.001 | 4.06* | 1.00 | Different |

As shown in Table 4, after the experimental group used the application, their perception test scores showed no difference, while their writing scores before and after using the application were significantly different. The students' writing scores after using the application were higher than they were before the using the application by 2.90 points.

The students in the control group before and after in-class learning (Non-App.) showed a significant difference in their scores before and after studying in class. The perception scores significantly decreased to 3.54 points after class learning, while the word spelling scores were higher at 1.70 points after class learning.

**Table 5** Correlation (r) between tonal perception and word spelling scores among the two groups

| Skill | Group | Mean | F-Test | Sig. | Scores difference | SD. | Meaning |
|---|---|---|---|---|---|---|---|
| Perception | Experimental group App. | 15.52 | 16.384 | < 0.001 | 4.06* | 1.003 | different |
| | Control group Non-App. | 11.46 | | | | | |
| Writing | Experimental group App. | 3.72 | 6.132 | 0.015 | 1.62* | 0.654 | different |
| | Control group Non-App. | 2.10 | | | | | |

* Sig at 0.05 level

Table 5 shows that the experimental group had significantly different perception and writing scores comparing to that of the control group. Those in the experimental group who used the application had higher perception scores than those in the control group (who did not use the application) at 4.06 points. The writing scores of the experimental group who used the application were also higher than those of the control group who did not use the application, at 1.62 points.

The results, therefore, indicate that possessing a good level of tonal perception did not always translate to a good writing skill level.

The correlation (r) between the tonal perception and writing scores produced by the two groups were as follows:

**Table 6** The correlation (r) of the post-test perception and writing skills among the two groups

| correlation (r) | | Experimental group App | | Control group Non-App | |
|---|---|---|---|---|---|
| | | Post-test perception | Post-test writing | Post-test perception | Post-test writing |
| **Post-test perception** | **Pearson correlation** | 1.000 | ***0.470**** | 1.000 | -0.246 |
| | **Sig. (2-tailed)** | | 0.001 | | 0.085 |
| **Post-test writing** | **Pearson correlation** | | 1.000 | | 1.000 |
| | **Sig. (2-tailed)** | | | | |

Table 6 shows the correlation between perception and writing skill of the post-test of the two groups. It was found that, in the experimental group, the perception significantly related to the writing skill at a moderate level (r = 0.470). In other words, when the perception scores increased, the writing scores also increased. The experimental group (App.) and the control group (Non-App.) showed a diverse relationship between perception scores and writing scores (r = -0.246). When the perception scores were high, the writing scores were lower.

## Discussion

This study aimed to compare the difference between Thai tone perception before and after using the Thai Tone Application among Chinese students aged 15–22 years with a low proficiency in Thai. This study compared participants' written spelling of Thai words before and after using the application with the control group's results before and after in-class learning to analyze the relationship between Thai tone perception and written spelling ability.

The results showed that, in the experimental group (App.), only 2 out of 50 students increased their tonal perception score by over 50%, while no students in the control group (Non-App.) increased their tonal perception scores. Meanwhile, 32 participants in the experimental group improved their written spelling by 5–68% after using the application. In the control group, 19 students increased their writing scores by 5–32%. These results suggest that the use of the application partially helped improve the Thai listening and writing skills of some Chinese students with a low proficiency in Thai. When comparing the use of the application and in-class learning (App.), the results showed that the application helped students develop their perception and writing skills better than in-class learning (Non-App.). The present study showed similar results to results found by Kim (2013), who noted that use of the application helped learners develop their English listening skills. Further research by Suwantarathip & Orawiwatnakul (2015) also showed that 80 university students significantly improved their tonal perception after using the application.

Interestingly, the Thai Tone Application improved participants' writing skills more than their perception skills (See Table 4). The reason for this could be that the application contains certain motivational tools, such as live correction and a spelling game, which make memorizing and learning how to spell words correctly more fun for users. According to Viberg & Grönlund (2013), mobile learning may help students enjoy the

process of learning, which may result in improved language proficiency.

In terms of the correlation (r) between tonal perception and writing skill, the results of the experimental group (App.) demonstrated a positive relationship, while the results of the control group (Non-App.) indicated a negative relationship. The results of this study indicate that possessing good tonal perception does moderately translate into good writing skills; this finding is similar to the research results of Flege & Schmidt (1995), Flege et al. (1997), Hattori & Iverson (2018), and Sakai & Moorman (2017), though research by Bozorgian (2012) and Shanahan (2006) noted a moderate correlation between speaking skills and writing skills.

The results indicating that the application did affect tonal perception and showed a moderate correlation between tonal perception and written spelling ability among Chinese students with a low proficiency in Thai language, which can be explained through the encoding and decoding theory (Vellutino & Scanlon, 1986). As Vellutino et al. (2004, p.28) describe,

> *"Phonological coding is the ability to use speech codes in order to represent words. Research (Blachman, 2000; Fletcher et al., 1994; Wagner, et al., 1994) has shown that deficiencies in phonological skills is the basic cause of dyslexia and that training in phonological awareness and letter-sound mappings has a positive effect on word identification, spelling and reading."*

That is, the students in this present study who used the Thai Tone Application was taught to be familiar with the Thai tone phonemes. The tone phoneme realization has affected the recognizable graphemes or word spelling in the students.

Yalcinkaya et al. (2009) state that tonal perception ability and speaking ability affect writing skill, so the tonal practice application is able to link the learning of all skills. Therefore, the claim that better speech perception leads to better speech production (Simser, 1998) was not substantiated by the results of this study and requires further investigation.

The research findings did not show a significant improvement in participants' perception skills after using the application, which may be because interactions with a mobile application cannot replace real life interactions with teachers. Another reason could be that the time the students spent using the application to practice their language skills may not have been sufficient and may not have been considered as important as other subjects.

Mobile applications should be utilized as a learning material in classrooms as they can motivate students and help them understand the language being studied more easily; however, they still cannot completely replace instruction by real teachers.

Regarding the minimal pair approach integrated in the Thai Tone Application, there is no doubt that phonemic contrast in the tone position is effective. The results of using an application containing tonal phoneme contrast or minimal pairs can facilitate production, but not perception. This is in line with findings by Gierut (1992) and Barlow & Gierut (2002), who note that perception can be facilitated by treating phonemes that differ maximally in major class properties, such as a low tone vs. a rising tone (a low tone is of a low level in shape, while a rising tone is mid-low-rising in shape). However, in the application used in this study, the minimal pairs of tonal

contrast were not the maximal opposition (e.g. the mid tone vs. the low tone). It is possible that the tonal contrast minimal pairs have caused the relationship between tone perception and tone production to be at the moderate level. This can be a potential point for future research. However, this research results confirm that the minimal pair approach is applicable to the suprasegmental features as well as the segmental units.

## Conclusion

In conclusion, tones are perceived as major difficulty for foreigners learning Thai language, this study attempts to promote tone perception in order to enhance the learners' production. However, it is found that a correlation between Thai tone perception and writing skill is at a moderate level in learners with low Thai language proficiency using the mobile phone application called "Thai Tone Application". It is suggested that instructors continue to play a crucial role in improving Thai tones of learners and using the application as a supplemental material may enhance better learning outcomes.

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