THE USE OF AUGMENTED REALITY TO ENHANCE ENGLISH PRONUNCIATION ABILITY OF ENGLISH TEACHER STUDENTS AT CHIANG MAI RAJABHAT UNIVERSITY

การใช้เทคโนโลยีความจริงเสริมในการพัฒนาความสามารถในการออกเสียงภาษาอังกฤษของนักศึกษาครู วิชาเอกภาษาอังกฤษ มหาวิทยาลัยราชภัฏเชียงใหม่

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Independent Study Title	The Use of Augmented Reality to Enhance English Pronunciation Ability of English Teacher Students at Chiang Mai Rajabhat University
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Program : English Language Studies

Independent Study Advisor

: Assistant Professor Dr. Chalermchai Chaichompoo **Chairperson**

ABSTRACT

The objectives of this independent study were 1) develop and verify the efficiency of the pronunciation lessons with the incorporation of AR with the specified 75/75 criteria, 2) to compare students' pronunciation ability before and after learning with the AR-incorporated pronunciation lessons, and 3) to explore the students' satisfaction with the AR-incorporated pronunciation lessons. The sample group composed of 39 third-year English teacher students selected by applying the cluster sampling method. The research instruments consisted of AR-incorporated pronunciation lessons, a lesson plan, a pronunciation test, a questionnaire, and interview questions. The data were analyzed using descriptive statistics including percentage, mean, standard deviation, and t-test. The results revealed that by using the AR English pronunciation application, the students' pronunciation ability improved significantly. The efficiency of the AR-incorporated pronunciation lessons was 76.73/76.10, which was higher than the 75/75 efficiency criteria. The post-test mean scores were significantly higher than the pre-test mean scores at the .05 level. Moreover, the students were satisfied with the developed pronunciation lessons at a high level.

Keywords: Augmented Reality (AR), AR Application, English Pronunciation, English Teacher Students

หัวข้อการค้นคว้าอิสระ : การใช้เทคโนโลยีความจริงเสริมในการพัฒนาความสามารถในการออกเสียงภาษาอังกฤษของนักศึกษาครู วิชาเอกภาษาอังกฤษ มหาวิทยาลัยราชภัฏเชียงใหม่

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บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อ 1) พัฒนาและประเมินประสิทธิภาพของบทเรียนการออกเสียงโดยใช้เทคโนโลยีความจริงเสริม (Augmented Reality: AR) โดยใช้เกณฑ์ 75/75 2) เพื่อเปรียบเทียบความสามารถในการออกเสียงของนักศึกษาก่อนกับหลังใช้บทเรียน AR และ 3) เพื่อสำรวจความพึงพอใจของนักศึกษาต่อบทเรียนดังกล่าว กลุ่มตัวอย่างคือนักศึกษาครุศาสตร์ สาขาวิชาภาษาอังกฤษ มหาวิทยาลัยราชภัฏเชียงใหม่ ชั้นปีที่ 3 จำนวน 39 คน ซึ่งคัดเลือกจากการสุ่มตัวอย่างแบบกลุ่ม เครื่องมือที่ใช้ในการวิจัยได้แก่ บทเรียนการออกเสียง AR แผนการสอน แบบทดสอบการออกเสียง แบบสอบถาม และคำถามที่ใช้ในการสัมภาษณ์ วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนาได้แก่ ค่าร้อยละ ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน และ t-test ผลการวิจัยพบว่าความสามารถในการออกเสียงของนักศึกษาหลังจากใช้บทเรียน AR มีการพัฒนาอย่างเห็นได้ชัด ค่าประสิทธิภาพของบทเรียน AR อยู่ที่ 76.73/76.10 ซึ่งสูงกว่าเกณฑ์ที่กำหนดคือ 75/75 นอกจากนี้คะแนนเฉลี่ยการออกเสียงของนักศึกษาหลังใช้เครื่องมือเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติที่ระดับ .05 และนักศึกษามีความพึงพอใจต่อบทเรียนการออกเสียง AR ในระดับสูง

คำสำคัญ : เทคโนโลยีความจริงเสริม (Augmented Reality: AR), แอปพลิเคชันเทคโนโลยีความจริงเสริม, การออกเสียงภาษาอังกฤษ, นักศึกษาครูวิชาเอกภาษาอังกฤษ

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Pitchaporn Opas

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CHAPTER 1

INTRODUCTION

Background and Rationale

In this era, English is the most significant language as it acts as an international language or lingua franca used by people around the world. English is regarded as a medium tool for communication between people who have different native tongues. Besides, English is necessary in terms of tourism, work, and education. In many countries, children are taught and encouraged to learn English as a second language or foreign language. In Thailand, English has been taught to students since they were young. However, many Thai students have low English speaking ability due to several factors, such as, shyness, lack of vocabulary knowledge, fear of making mistakes, incorrect pronunciation and so forth (Juhana, 2012). Moreover, unintelligible pronunciation is a major problem in speaking English for Thai people since English is not their native language (Khamkhien, 2010). Unintelligible pronunciation can lead to ineffective communication and may cause misunderstanding and misinterpretation between communicators. Pronunciation issue is not emphasized enough in English language classroom in Thailand. Many teachers place an importance on other skills of language. Furthermore, some teachers have found it difficult to integrate pronunciation with other language skills, so the students lack knowledge about the importance of the intelligible pronunciation and how to have the intelligible pronunciation (Rajadurai, 2007). In addition, many research studies have revealed that stress and intonation are the main English pronunciation problems for Thai undergraduate students in terms of suprasegmental level (Chomphuboot, 2005; Isarankura, 2018; Khamkhien, 2010; Narksompong, 2007).

At the university level, it is advisable that English teacher students should have correct pronunciation in order to teach their students in the future correctly. However, most of the English teacher students at Chiang Mai Rajabhat University still

have pronunciation problems as can be seen from the results of the pronunciation test that the researcher gave them. The mean scores were 27 out of 50 which were lower than the 60% of the full scores. This problem can be caused by several factors, such as, their exposure to the English language, their motivation in learning, and their first language interference (Yoshida, 2016). If this problem cannot be solved, it will cause troubles to their students in the future. Additionally, incorrect pronunciation could cause misunderstanding when communicating with others. As a result, they should be provided an additional tool to help them improve their English pronunciation and they can learn it by themselves anywhere and anytime.

Malithong (2005) suggested that learning and teaching management should involve students and be based on real situations or actions so as to provide a direct experience to learners. Furthermore, Suwancharas (2016) believed that technology plays an important role at present. It is a part of people's lives in all aspects including teaching and learning, such as, computer assisted teaching, A.I teaching system, and online lessons. Currently, Augmented Reality (AR) technology has been applied in many classrooms. It is a current learning tool which is an authentic material that can stimulate and attract learners as well as give students a sense of reality. Many research studies have found that this tool can motivate students in learning (Diegmann, Schmidt-Kraepelin, Eynden, & Basten, 2015; Kesim & Ozarslan, 2012; McAleer, 2011).

As a consequence, in this study, augmented reality technology (AR) was used to improve a major problematic English pronunciation of English teacher students at Chiang Mai Rajabhat University which are stress and intonation. Thus, the pronunciation lessons were developed by utilizing the AR technology. The improvement of the students' English pronunciation after using the developed AR lessons was also investigated. Moreover, the students' satisfaction with the use of augmented reality technology after the intervention was explored. One major benefit of this study is the English pronunciation improvement of the students. Besides, in the future, the researcher may use this research as a basis to develop teaching and learning innovation that might help to improve English pronunciation and other English language skills.

Research Objectives

1. To develop and verify the efficiency of the pronunciation lessons with the incorporation of AR technology to enhance the problematic English pronunciation ability of English teacher students with the specified 75/75 criteria

2. To compare students' pronunciation ability before and after learning with the AR-incorporated pronunciation lessons.

3. To explore students' satisfaction towards the AR-incorporated pronunciation lessons.

Expected Results

1. An effective learning medium which is the AR-incorporated lessons to improve English pronunciation is established.

2. AR technology can enable learners to improve their English pronunciation ability

Research Hypothesis

The post pronunciation ability of the students learning with the pronunciation lessons with the incorporation of AR technology was higher than that of the pre-learning counterpart ability.

Research Scope

Population and Sample Group

Population of this study was 119 English teacher students at Chiang Mai Rajabhat University enrolling in the Phonetics course in the 2019 academic year. The sample group was selected from the population using the cluster sampling method. The sample group consisted of 39 third-year English teacher students.

Scope of Content

This study used AR English pronunciation application which was designed and generated by an Augmented Reality (AR) software called "*ZapWorks*" to improve English pronunciation, which are stress and intonation. The stress and intonation lessons were developed into eight units, including word stress and sentence stress, and English intonation patterns and discourse.

Scope of Time and Place

The participants were assigned to use the AR application at least once a week (every Saturday) within two months in the second semester of the 2019 academic year at Chiang Mai Rajabhat University.

Definition of Terms

Augmented Reality Technology refers to the use of an AR mobile application called Zappar which consists of various kinds of multimedia including images, videos, audios, and texts to assist teaching and learning English pronunciation.

Pronunciation lessons with the incorporation of AR technology refers to eight pronunciation lessons related to English stress and intonation using the AR application to present the lessons to the students.

Teaching English pronunciation refers to teaching English pronunciation focusing on stress and intonation which consisted of three procedures including 1) opening, 2) self-study with AR application, and 3) closing.

English pronunciation ability refers to students' ability in pronouncing English words and sentences correctly in terms of stress and intonation measured by the oral test developed by the researcher.

Teacher students refers to the English teacher students at Chiang Mai Rajabhat University who attended the Phonetics course in the academic year 2019.

Students' satisfaction refers to satisfaction of the students toward the pronunciation lessons with the incorporation of AR technology.

Conceptual Framework

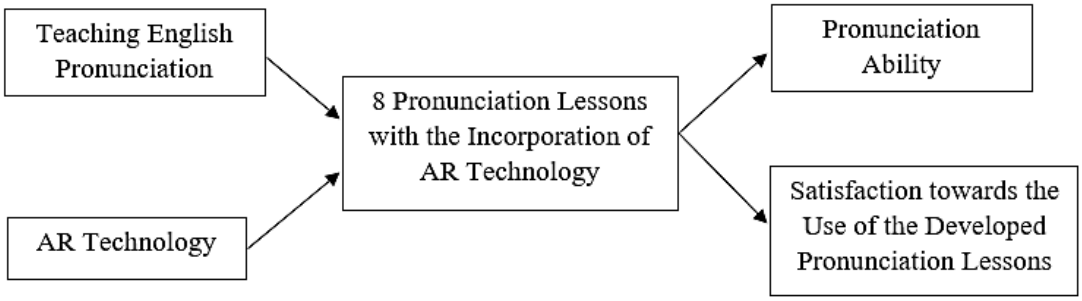

Figure 1.1 The Conceptual Framework

CHAPTER 2

LITERATURE REVIEW

This chapter provides a review of the literature that is relevant to the research. The first section reviews the issue of teaching English pronunciation. The second section focuses on AR technology. The final section provides the related studies. In detail, each section consists of the following topics.

1. Teaching English Pronunciation
    - 1.1 Definition of Pronunciation
    - 1.2 Significance and Goals of Teaching and Learning Pronunciation
    - 1.3 General English Pronunciation Problems of Thai People
    - 1.4 Factors Affecting English Pronunciation Ability
    - 1.5 How to Teach Pronunciation
2. Augmented Reality (AR) Technology
    - 2.1 Definition of Augmented Reality (AR)
    - 2.2 Brief History of Augmented Reality
    - 2.3 Types of AR
    - 2.4 AR Devices
    - 2.5 Augmented Reality in Education
    - 2.6 Benefits of AR for Teaching and Learning
3. Related Studies

Teaching English Pronunciation

This section reviews literature related to English pronunciation instruction including definition of pronunciation, significance and goals of teaching and learning pronunciation, general English pronunciation problems of Thai students, factors affecting English pronunciation ability, and how to teach pronunciation.

Definition of Pronunciation

There are various linguists and researchers who have defined the word "pronunciation". Some examples of those definitions are as follows.

According to Cook (1996, as cited in Gilakjani, 2016), pronunciation is the way English sounds are produced. People can learn to have correct pronunciation by repeating, and improving their pronunciation.

Pronunciation refers to the utterance of a language or a particular word or sound. It can also be defined as the way in which the words of a language are pronounced by a particular person (Hornby, 2010).

Otlowski (1998) defined pronunciation as the production of a word in an accepted way, and it is understandable.

Pronunciation refers to the way in which a certain sound or sounds are uttered (Richards & Schmidt, 2002).

Pronunciation was defined as the way sounds in a language are made or a person's way of speaking a language (Trappes-Lomax, 1997).

Yates (2002, as cited in Gilakjani, 2016) described the word "*pronunciation*" as the utterance of sounds that have meaning. It includes segmental, suprasegmental features, and voice quality.

It can be concluded that pronunciation is the way in which a particular word or sound is uttered in an accepted manner.

Significance and Goals of Teaching and Learning Pronunciation

Pronunciation instruction is a basis and significant skill of English. It plays an important role in development of other English skills, including, listening, speaking, reading, writing, and other English comprehensive competence. Many experts have described the importance of pronunciation instruction and its goals as detailed in the following paragraph.

Pronunciation instruction is important for second or foreign language learners. Kelly (2000) pointed out that correct pronunciation can reduce the misunderstanding that occurs when pronouncing words incorrectly. A meaning of a word can be changed if it is pronounced incorrectly (Burns, 2003). As a result, pronunciation instruction is necessary. According to Harmer (2001), pronunciation teaching and learning cannot only help to raise students' awareness on different sounds and sound features in English, but also improve students' speaking skill. Communication will be successful if communicators understand each other. Pronunciation is a part of effective communication. Hismanoglu (2006) confirmed that pronunciation instruction is very significant for oral communication as it is a major part of communicative competence. In fact, native speakers do not focus on grammar or vocabulary because they can be useless if the speaker cannot pronounce words correctly. As a result, accurate pronunciation is important for communicative efficiency (Harmer, 2001). Correct pronunciation could lead to effective communication, while incorrect pronunciation may cause communication breakdown.

There are varied goals of teaching and learning English pronunciation. The first goal of teaching and learning pronunciation is to have native-like or perfect pronunciation. According to Yoshida (2016), most teachers expressed that they want their students to be able to speak English with good pronunciation, but it is difficult to define what good pronunciation is. Some people define the word "good" in "good pronunciation" as sounding like a native speaker. Kenworthy (1987) mentioned that, in the past, the pronunciation goal was to have native-like pronunciation. Learners should have the same pronunciation and accents like the native English speakers. Additionally, Harmer (2001) stated that the perfect pronunciation in the past was having the British or American accents. However, it is problematic for English language learners to have native-like pronunciation because it is difficult to define what a native speaker sounds like, and the word "perfect pronunciation" depends on attitude of listeners. There are many varieties of English, so it is hard to meet the ideal pronunciation (Yoshida, 2016). Therefore, the second goal is established. The new goal for pronunciation instruction is to have intelligible pronunciation. This goal is more realistic (James, 2010). Kenworthy (1987) defined word intelligibility as "being understood by a listener at a given time in

a given situation" (p.13). It is similar to word understandability. Thus, comfortably intelligible pronunciation is the pronunciation that is easily understood by listeners. Levis (2005) and Well (n.d.) supported this idea that English pronunciation learners should improve their pronunciation to meet the satisfaction of being understood by both native and non-native English speakers. In other words, their goal of pronunciation learning is to improve the intelligibility and comprehensibility of their speech, and it is not necessary to have the native-like pronunciation. In the same way, Harmer (2001) and Kenworthy (1987) believed that the main purpose of teaching and learning a language is to effectively communicate in the target language and in the real context. Although some English sounds are not pronounced precisely by foreign speakers, it is acceptable if the listeners are able to receive all of the messages which can be considered as an effective communication. On the other hand, if the listeners cannot understand the speakers, it is called unintelligible pronunciation which can cause problems in communication. The other goal of teaching and learning pronunciation is also to help learners feel more comfortable in using English and to develop a positive self-awareness as non-native speakers in oral communication (Butler-Pascoe & Wilburg, 2003). Although there is flexibility in the way a learner can pronounce English, if the English learners want to be clearly understood when they speak English and if they want to be able to easily understand what others are saying, they should improve their pronunciation. They need to understand that if their pronunciation is more natural, their listening will improve (Gilakjani, 2011).

To summarize, pronunciation instruction is significant because it enables students to improve their pronunciation which is a part of speaking skill. Pronunciation is also a major part of communicative competence. Incorrect pronunciation can cause misunderstanding, so it is essential to learn pronunciation. Moreover, there are three goals of teaching and learning pronunciation which are to have native-like pronunciation, to have intelligible pronunciation as well as to help learners feel more comfortable in using English and develop a positive self-awareness as non-native speakers in oral communication.

General English Pronunciation Problems of Thai Students

Many Thai students have problems in speaking English in various aspects. A major problem deals with unintelligible pronunciation which leads to ineffective communication as students cannot produce understandable speech. Pronunciation problems in both segmental and suprasegmental levels found by researchers were described as follows.

Segmental level

It was revealed that Thai students have problem in pronouncing some English consonant and vowel sounds. Wei and Zhou (2002) found that there are some consonants and vowels that Thai students always have problem with, such as the mispronouncing of /r/ and /l/, final sounds, consonant clusters, and words with /ð/. Winaitham and Suppasetseree (2012) discovered some consonant sounds that cause difficulty for Thai students because they do not exist in the Thai sound system, such as /θ/, /ð/, and /ʤ. The consonant clusters and the final sounds with –d and –ed are also the problems for students. Furthermore, nine consonant sounds are found to be difficult to utter for Thai students due to the differences between English and Thai sound systems including /g/, /v/, /ð/, /θ/, /z/, /ʃ/, /ʒ/ /tʃ/, and /dʒ/ (Dee-in, 2006; Kanokpermpoon, 2007). Kanokpermpoon added that /l/ and /r/ tend to be used interchangeably. In addition, Dee-in inserted that some English vowel sounds caused difficulty for Thai students to pronounce including /iː/, /ɪ/, /e/, /ə/, /ʊ/, /uː/, /au/,/eɪ/, and /eə/.

Suprasegmental level

At the suprasegemental level of English, stress and intonation are the main pronunciation problems for Thai students. It was found that Thai students cannot produce the English language in terms of stress and intonation correctly (Chomphuboot, 2005; Isarankura, 2018; Narksompong, 2007; Wei & Zhou, 2002; Winaitham & Suppasetseree, 2012). According to his study, Khamkhien (2010) confirmed that stress is a major problem of Thai students. Additionally, voicing (Wei & Zhou, 2002) and linking (Winaitham & Suppasetseree, 2012) are also reported as Thai students' pronunciation problems.

In conclusion, Thai students have pronunciation problems in both segmental and suprasegmental levels. There are some consonant and vowel sounds which are

difficult to utter due to the differences of the sound systems between Thai and English. In the suprasegmental level, stress and intonation are found in many studies as major pronunciation problems for Thai students. Moreover, some Thai students also have problems with voicing and linking.

Factors Affecting English Pronunciation Ability

There are several factors that can contribute to pronunciation problems of learners including age, motivation, exposure to the target language, first language interference, phonetic ability, and instruction.

1. Age

It is believed that age can affect language learning ability. Harmer (2001) claimed that children can pick up a new language easier and faster than adults because of the brain functions. Yoshida (2016) supported that children easily absorb the sounds and words they hear around them and learn to imitate accurately. It was found that most immigrant children can speak the language of the new community with a native-like pronunciation. On the other hand, their parents cannot speak with native-like pronunciation of the target language (Lightbown & Spada, 2013). Although adults learn to speak a second language fluently, they still maintain their foreign accent (Kenworthy, 1987). However, there are some truths about these beliefs that most children can learn things easily, but the fluency of speaking a language and accent is individualistic. Some adults might learn things faster than some children because of their aptitude or intelligence in learning languages (Harmer, 2001; Kenworthy, 1987). It can be said that age does matter for some people to learn a new language.

2. Motivation

Motivation is an important factor that affects learners' pronunciation. It is evident that positive motivation is correspondent with a willingness to keep learning (Lightbown & Spada, 2013). According to Kenworthy (1987), some students seem to be more concerned about their pronunciation than others. This is because those students have motivation to drive or push themselves to learn a second language. Students who are more concerned about their pronunciation have better pronunciation than those who are less concerned. Teachers can provide knowledge and chances to practice pronunciation for students, but they do not have to force to change students' pronunciation. Teachers should encourage students to have motivation, so that

students will be willing to improve their pronunciation themselves (Yoshida, 2016). According to Harmer (2001), there are some sources of motivation. Firstly, the society where learners live in, the importance of a language in the society that learners live in is a source of motivation to learn that language. Secondly, attitude is quite an important source of motivation. Students who have positive attitude towards the target language and its speakers will learn that language better (Gilakjani, 2012). Lastly, Winaitham and Suppasetseree (2012) suggested that teachers and their teaching methods are very important because a teacher is a major source to drive or motivate students to learn a language and the teaching methods can also help motivate students in learning.

3. Exposure to the target language

Learners who have more opportunities to expose to the English language will have better pronunciation than those who do not have chances. According to Yoshida (2016), students' pronunciation learning is affected by how much English they have an opportunity to hear in their daily life. Students who have more opportunities to use English with native speakers in everyday lives will have better pronunciation than those who do not use it or use it with non-native speakers (Gilakjani, 2012; Kenworthy, 1987). Winaitham and Suppasetseree (2012) also recommended that students should be given an opportunity to use English not only in class, but also in the real context because it could encourage students to be exposed to the target language. For example, in Thailand, EFL students have fewer opportunities to be exposed to the English language, so it can cause the failure to Thai students in using English in all aspects (Dhanasobhon, 2006).

4. First language interference

Learners' pronunciation ability is mainly affected by their first language. According to Yoshida (2016), a learner's first language has a strong influence on the way a learner learns and produces pronunciation of a second language. In the same way, it is common that the native language will interfere and transfer to the target language when speaking. It can be called accent (Gilakjani, 2012). Yoshida added that this factor can be helpful for some native speakers who have similar native languages to the target language. However, learning a second or foreign language can be difficult for people who have their first language which is very different from the new language. Furthermore, Hurn and Tomalin (2013) explained that standard form of

English is no longer used throughout the world because it is localized by many local dialects. It is called “language localization”. English adapts to the needs of local communities. As English is spoken by a billion non-native English speakers, there are a variety of English used by people around the world. It can cause some misunderstanding between people even though they speak the same language.

5. Phonetic ability

Learners have different phonetic ability to learn a language. According to Brown (1992) and Yoshida (2016), some people seem to have more ability or talent for learning language or imitating pronunciation than others. This is a natural talent called “aptitude” which refers to the ability to learn a particular thing quickly. Thus, a learner who has a high aptitude of learning a language will learn a language faster than others (Lightbown & Spada, 2013). In the same way, Kenworthy (1987) reiterated that some people have “better ear” for foreign language than others. This aptitude is different from one person to another. Some people can learn a second language easily and quickly, while others cannot learn well.

6. Instruction

Instruction is a major factor that influences students’ pronunciation ability. Pronunciation is usually seen as the least important skill of English to teach. Harmer (2001) and Kenworthy (1987) found that many English teachers do not place an importance on teaching English pronunciation. According to Elliot (1995), teachers tend to view pronunciation as the least useful of the basic language skills. Gilakjani (2012) confirmed this idea that most teachers only focus on the four main skills of the English language: reading, writing, speaking, and listening. Winaitham and Suppasetseree (2012) noted that many Thai EFL classes place a great emphasis on English grammar, structure, and vocabulary. However, they do not place an importance on pronunciation which is one of the most important skills for communication. Some teachers only focus the pronunciation aspect only in the first year or in a specific course. In addition, pronunciation is neglected because it is too regarded as difficult for learners and it could be a waste of time (Harmer, 2001). Furthermore, some teachers think pronunciation instruction is not necessary for some learners (Kenworthy, 1987). Thus, the lack of emphasis on pronunciation can negatively affect the students’ pronunciation. Moreover, to teach pronunciation, teachers should have adequate knowledge and skills,

otherwise students will receive wrong knowledge and cannot produce intelligible pronunciation. According to Yoshida (2016), quality of teaching that students receive certainly affects the quality of their learning, so teachers should have intelligible pronunciation first and pass it on to students. Similarly, English teachers should have adequate knowledge and skills of English pronunciation, and help their students in learning and producing correct pronunciation (Winaitham & Suppasetseree, 2012).

How to teach pronunciation

Many experts have studied about strategies used for teaching pronunciation. There are some examples of those strategies as detailed below.

Scarcella and Oxford (1994) provided eleven techniques for teaching pronunciation as follows.

1. Self-monitoring: teachers encourage students to self-monitor their pronunciation to improve their intelligibility.
2. Tutorial sessions and self-study: teachers instruct students in class and design instruments for students to study by themselves.
3. Modeling and individual correction: teachers report the results of analyses of student pronunciation individually.
4. Communication activities: teachers design activities for students to practice specific pronunciation sounds and features.
5. Written versions of oral presentations: students are instructed to analyze the written versions of their oral presentations.
6. Computer-assisted language learning: teachers use any kind of computer technology to assist pronunciation instruction.
7. Explanations: teachers explain about theory of pronunciation in some circumstances.
8. Utilization of known sounds: teachers compare students' first language and target language to help students understand the lessons more clearly.
9. Incorporation of novel elements: teachers use novel elements with the use of directions.
10. Communication strategies: teachers can teach students some useful communication strategies to help them improve their pronunciation.

11. Affective strategies: Various excellent affective strategies can be taught to help students decrease their anxieties and gain more confidence.

Lin, Fan and Chen (1995) suggested their strategies to teach pronunciation in four parts: intonation, stress and rhythm, consonants and vowels. They claimed that many L2 students pay too much attention to sounds, vocabulary, and grammar. They pay very little attention to pitch changes, so their pronunciation is monotonous. The authors suggested teachers to teach pronunciation by drawing pitch lines, curves, or arrows as well as using musical scores.

Cheng (1998) recommended the following strategies to teach pronunciation. Firstly, teachers choose and provide meaningful materials that can help students learn and practice pronunciation. Secondly, teachers use games or additional instruments that can help to increase student motivation in a pronunciation class. Finally, teachers assess students' progress and understanding to the lessons.

According to Schaetzel and Low (2009), four strategies for teaching pronunciation are recommended. First, teachers give students background lessons and create a positive classroom atmosphere. Second, teachers identify specific pronunciation features that caused problems for learners. These features should be focused in class. Third, teachers raise learners' awareness on prosodic features of language including word stress, intonation, and rhythm. They are extremely important to comprehensibility, so teachers should include these topics in instruction. Last, teachers try to develop learners' communicative competence by exposing students to English conversation.

To conclude, each expert provided useful suggestions for teaching pronunciation. Scarcella and Oxford (1994) suggested eleven techniques for teaching pronunciation, which are self-monitoring, tutorial sessions and self-study, modeling and individual correction, communication activities, written versions of oral presentations, computer-assisted language learning, explanations, utilization of known sounds, incorporation of novel elements, communication strategies, and affective strategies. Lin, Fan and Chen (1995) recommended teachers to teach pronunciation by drawing pitch lines, curves, or arrows as well as using musical scores. Cheng (1998) suggested teachers to provide meaningful materials to students, to use games and additional instruments in class, and to assess students' progress and understanding. In

addition, Schaetzel and Low (2009) provided four strategies for teaching pronunciation including creating positive classroom atmosphere, identifying specific problematic pronunciation features, making students aware of the prosodic features of language (stress, intonation, rhythm), and focusing on developing learners' communicative competence.

Augmented Reality (AR) Technology

This section introduces Augmented Reality (AR) technology and its use in education.

Definition of Augmented Reality (AR)

The definition of "*Augmented Reality (AR)*" was given in many sources. Some of its definitions are shown below.

Carmigniani and Furht (2011) defined Augmented Reality as a real time direct or indirect view of real world environment enhanced by inserting virtual computer generated information.

Nincarean, Alia, Halim, & Rahman (2013) explained Augmented Reality as the integration of virtual objects into real scenes.

Augmented Reality is a concept of enhancing a user's learning experiences by displaying digital content overlaid on top of real world scenes (Rattanarungrot, White & Newbury, 2014).

Augmented Reality was described as "a direct or indirect view of a real-world environment in which elements like sound, video, graphics are augmented by computer-generated sensory inputs (Joan, 2015).

According to Merriam-Webster Dictionary (2017), Augmented Reality is a technology that creates a version of reality by overlaying digital information on an image being viewed through a device, such as, a smartphone camera.

Bonner and Reinders (2018) defined Augmented Reality as a range of location, motion and information technologies that enhance reality with digital resources in which users interact with information and other users. It is a technology that uses the camera of a tablet or phone to provide the combination of the real world environment and digital objects.

It can be concluded that Augmented Reality is a technology that provides users a combination of real and computer-generated elements in real time being viewed through a smart phone or tablet.

Brief History of Augmented Reality

According to Carmigniani and Furht (2011) and Augmented reality – the past, the present and the future (2019), the appearance of Augmented Reality (AR) was first achieved in 1950s when Morton Heilig, a cinematographer, had an idea that the viewer could be drawn into the onscreen activity by taking in all the senses in an effective manner called "Sensorama", such as, visuals, sounds, vibration and smell. In 1960s, Ivan Sutherland, the American computer scientist and early Internet influence, invented the head-mounted display. After that, he created an augmented reality system using an optical see-through head-mounted display. In 1975, Myron Krueger creates the Videoplace, a room that allows users to interact with virtual objects for the first time. Later, Tom Caudell and David Mizell utilized Augmented Reality technology for aviation. In the same year, L.B Rosenberg developed one of the first functioning AR systems, called Virtual Fixtures and demonstrated its benefit on human performance. Additionally, Steven Feiner, Blair MacIntyre and Doree Seligmann presented the first major paper on an AR system prototype named "KARMA". In 1997, Ronald Azuma writes the first survey in AR providing a widely acknowledged definition of AR by identifying it as combining real and virtual environment while being both registered in 3D and interactive in real time. In 2005, the Horizon Report predicted that within four or five year, AR technologies would emerge more fully, and camera systems would be developed in the same year. In the following years, more and more AR applications were developed especially with mobile applications, such as Wikitude.

Types of AR

According to Katiyar, Kalra, and Garg (2015), there are two main types of simple augmented reality including marker-based AR and markerless AR.

1. Marker-based AR

Marker-based AR needs cameras and visual cues. A camera is used with AR software to detect augmented reality markers like images as the location for virtual objects. An image can be viewed on a screen and digital elements are placed into the scene at the location of the markers. This type of augmented reality has a

limitation as it can be utilized with a particular recognized software. The simplest types of augmented reality markers are black and white images that consist of two-dimensional (2D) barcodes.

2. Markerless AR

This type of AR does not require a marker to display the content, but positional data. It relies on positional information gathered through the internet or from a device's camera, GPS, digital compass, and accelerometer, and displayed on any specific location.

AR Devices

According to Carmigniani & Furht (2011), there are four main devices for augmented reality which are displays, input devices, tracking, and computers as follows.

1. Displays

There are three major types of displays used in Augmented Reality including head-mounted displays (HMD), handheld displays, and spatial displays. The first type of display is head-mounted displays (HMD). It is a display device worn on the head or as part of a helmet. Users can view both images of the real and virtual environment. The second type of the display is handheld display which is small portable computing devices with a display. Video-see-through techniques are used to overlay graphics onto the real environment and use sensors, such as digital compasses and GPS units. There are currently three distinct classes of commercially available handheld displays that are being used for augmented reality system which are smartphones, PDAs and Tablet PCs. The last type of displays is spatial displays. Spatial Augmented Reality make use of video-projectors, optical elements, holograms, radio frequency tags, and other tracking technologies to display graphical information directly onto physical objects without requiring the user to wear or carry the display.

2. Input devices

The input devices depend on the type of application. There are many types of input devices for AR systems, such as, utilizes gloves and a wireless wristband. In the case of smartphones, the phone itself can be used as a pointing device.

3. Tracking

AR tracking devices has different level of accuracy and depends on the type of system being developed. Examples of tracking devices are digital cameras, optical sensors, GPS, accelerometers, solid state compasses, and wireless sensors.

4. Computers

AR systems require powerful CPU and considerable amount of RAM to process camera images. For mobile computing systems, a laptop is used in a backpack configuration. However, iPad will be used to replace this backpack configuration. Moreover, stationary systems can use a traditional workstation with a powerful graphics card.

In this study, Zappar which is an AR application was used to provide English pronunciation lessons in the form of AR contents. Zappar is an input device in this study. The contents in the application are designed and generated by an easy-to-use AR software called ZapWorks. ZapWorks is a comprehensive platform that allows users to create any kind of interactive and immersive AR contents on personal computer (PC) or handheld devices (Zappar Ltd., 2019). Thus, the type of AR display in this study is handheld display. Some of its main features include: video widgets, photo albums, contact cards, social media, custom buttons, full analytics, tracking images, and 3D models. The software provides Zapcodes which is the AR tracking. Users can experience AR contents by using Zappar application to scan Zapcodes. Additionally, with the use of Zappar, users can turn various kinds of contents into an interactive delivery channel serving video, animation, games, competitions, additional information, data capture mechanics, and social share (Zappar Ltd., 2019).

According to ZapWorks Review (2019), there are three ZapWorks content creation tools including widgets, designer, and studio enables users to create any kind of AR experience. Firstly, the ZapWorks widgets provide an easy and quick way to integrate AR content to Zapcodes. It takes only a few clicks to attach video, photo, or any type of widget to the Zapcode. Zapworks manage the visual styling and technical aspects of AR content creation which means that users do not need to be IT experts in order to create an AR content. Secondly, the ZapWorks designer tool helps users create fully customized interactive AR content. It is also easy to use the designer tool due to its drag and drop interface. Users just drag and drop content, add interactivity with links

and actions, and customize the layouts to generate unique AR experiences. Lastly, the ZapWorks studio provides an all-inclusive toolkit for designing 3D AR or virtual reality (VR) experiences. The Studio helps users to deliver an immersive and dynamic experience with animation tools which include Gyroscope Oriented immersive environments.

Augmented Reality in Education

At present, Augmented Reality (AR) technology is successfully utilized in various fields of education, such as, science, biology, and math. According to Bonner and Reinders (2018), AR is not a new technology. In the past it was very expensive and highly specialized and fixed to one location. However, it becomes cheaper, and is available for general use and portable. Thus, this change benefits education as it provides opportunities for learners to easily access to the AR. The use of AR will increase in educational settings because more and more AR content is being created to use with smartphones which are becoming the main stream of e-learning (Wang, et.al. 2016). Kesim and Ozarslan (2012) provided that AR technology can be applied for education, entertainment, or edutainment. It can enhance users' perception of an interaction with the real world. The three-dimensional virtual image can be moved around and viewed from any viewpoint like a real object. Augmented Reality can also be used to enhance collaborative tasks. It is possible to develop innovative computer interfaces that combine virtual and real worlds to enhance face-to-face and remote collaboration.

In education, AR technology has been used in classrooms to assist teaching and learning because it can stimulate and attract learners. There are several examples of the use of AR in classrooms as follows. In an astronomy class, students learn about the relationship between the earth and the sun employing AR technology with 3D rendered earth and sun shapes. Moreover, augmented chemistry is an interactive educational lab that can show students how and what an atom or a molecule consists of via AR (Lee, 2012). According to Wang and Iwata (n.d.), AR can also be used for foreign language education in several ways and in various skills, such as listening and speaking, reading, vocabulary learning, and experiencing cultural differences. For example, AR application can be used to enhance vocabulary retention by installing AR application on a smartphone. Then, the user places a smartphone camera on a particular

object or flashcard, a vocabulary and related information will pop up on the smartphone screen. In this way, learners can learn vocabulary in a new and more interesting way.

According to Yuen, Yaoyuneyong, and Johnson (2011), there are five types of AR used in education including discovery-based learning, objects modeling, AR books, skills training, and AR gaming.

1. Discovery-based learning

AR can be used in applications that enable discovery-based learning of students. A user is provided with information about a real-world place while simultaneously considering the object of interest. Students can use their smartphones to explore a field trip or visit a site. AR discovery-based activities allow students to investigate of scenarios. This type of application is often used in museums, in astronomical education, and at historical places.

2. Objects modeling

Augmented reality can be used to model objects. This type of AR allows learners to see how a given item would look in different settings. Some AR applications allow students to design, manipulate, and rotate models. Besides, students can receive immediate visual feedback about their ideas and designs. This type of application is also used in architectural education.

3. AR books

AR Books are books that can offer students 3D presentations and interactive experiences through AR technology. It allows AR contents to be created for any normal books, bringing the books to life with animated and even interactive models. The books are augmented with the help of technological devices such as smartphones and special glasses. Users can experience 3D characters spring from each page in AR pop-up books. In addition, AR books can be used as an educational medium at the primary level. This kind of AR technology attracts students' attention.

4. Skills training

AR technology can support skills training as it has strong potential to provide powerful contextual experiences. AR goggles are used to train individuals, especially in special tasks, such as, hardware mechanics in the military, or airplane maintenance, at companies such as Boeing, where each step of a repair is displayed, necessary tools are identified, and textual instructions are included.

5. AR Gaming

Games are often used to assist teaching and learning. AR technology enables the development of games that are based in the real world. AR gaming is an effective tool for gaining students' interest and attention while teaching a variety of skills. For instance, games using marker technology including a flat game board or map which becomes a 3D setting when viewed with a mobile device or a webcam can be applied for archaeology, history, anthropology, or geography classrooms.

The type of AR used in this study is AR book since English pronunciation lessons were offered to students in the form of AR contents. Zappar, an AR application, provided AR pop-up lessons to the students with the help of technological device which is a smartphone or tablet.

Benefits of AR for Teaching and Learning

There are many benefits of augmented reality technology for teaching and learning as follows.

1. AR technology can increase motivation, attention, concentration, and satisfaction of learners (Diegmann, Schmidt-Kraepelin, Eynden, & Basten, 2015).

2. AR technology brings out the autonomous skill of learners and improves collaborative learning. It also provides more opportunities for learners to have direct experience because of the use of authentic materials as well as a rich contextual learning for individuals (Bonner and Reinders, 2018; Craig & McAleer, 2011; Diegmann et al., 2015; Yuen, Yaoyuneyong, & Johnson, 2011).

3. AR technology can increase information accessibility and interactivity (Bonner and Reinders, 2018; Diegmann et al., 2015).

4. AR technology can improve learning capability and increase creativity of learners (Diegmann et al., 2015).

5. AR technology enables learners to understand things easier as it helps to improve development of spatial abilities and memory (Diegmann et al., 2015).

6. It is claimed that AR applications can reduce direct costs for education and time for classroom preparation (Diegmann et al., 2015).

7. Mostly, AR technology is used with smartphones, so it is portable and easy to use. Learners and teachers can use it anywhere they want (Bonner and Reinders, 2018).

On the other hand, there are some limitations of AR technology for teaching and learning including costs, expertise of teachers, undeveloped pedagogical theories for AR used in education, and preference of learners. Wang and Iwata (n.d.) indicated that in order to create the AR learning content, teachers need to invest in hardware and software. Sometimes, teachers do not have an ability to create AR learning contents. Furthermore, the pedagogical theories for AR used in education are developed very slowly compared to the development of AR technology (Saidin, Abd Halim, and Yahaya, 2015; Wang and Iwata, n.d.). In addition, some learners prefer learning with teachers in class rather than using AR technology to assist learning because AR tool is sometimes complicated and difficult to use. It can be time-consuming due to the lack of the internet signal (Hsu & Huang, 2011).

To sum up, AR technology has numerous advantages for education. It is easy to use. It helps to increase learners' motivation, attention, concentration, satisfaction, autonomous skill, creativity, and information accessibility. It can also reduce direct costs for education and time for classroom preparation. However, there are some limitations of this technology that should be addressed including costs, expertise of teachers, undeveloped pedagogical theories for AR used in education, and preference of learners.

Related Studies

Since AR technology was applied in this study to enhance English pronunciation of the students, the previous studies related to the use of AR technology to improve English skills and increase motivation of learners are reviewed as follows.

Hsieh, Kuo and, Lin (2014) developed a mobile augmented reality English Learning application (MARELA) to assist English learning. They also examined students' learning motivation and acceptance of MARELA after experiment. The participants consisted of 106 seventh-grade students at a junior high school in Southern Taiwan. The research instruments used in this study were MARELA instructional material, the Instructional Materials Motivation Survey (IMMS) and acceptance questionnaire. The research statistics used in this study were mean and standard deviation. The participants were assigned to use MARELA application to assist the learning of English preposition of place. The findings revealed that the AR interactive

learning could raise the learning motivation of the students and most of them accepted the mobile AR English learning environment.

Küçük, Yılmaz, and Göktaş (2014) studied the achievement, attitude and cognitive load levels of students in learning English by using AR technology. The participants in this study consisted of 122 secondary school students from 5 different secondary schools in Erzurum, Turkey. An English course book was transformed into a magic book by the aid of marker-based AR technology. The instruments for collecting the data were AR applications attitude scale, cognitive load scale, and achievement test. The implementation phase was held for two weeks and two lessons for each week. In the study, descriptive and inferential analysis methods were used. The results of the study showed that using AR application to learn English could positively affect the students' learning achievement. Moreover, the students were satisfied with the AR application to assist English learning. They had a low anxiety level due to this approach. Additionally, it was found that the cognitive load levels of the students in the process of self-directed learning in AR environment were low.

Gündoğmug, Orhan, and Sahin (2016) studied the attitudes of learners towards an AR application that enabled learners to improve their listening skills and promoted the motivation towards listening activities by using smart phones and tablets. The study focused on AR assisted learning with listening activities in textbooks. The participants were 60 students in a secondary school. They were assigned to use augmented reality applications generated by AR social platform named "Aurasma". It was found that the students who used AR applications had a positive attitude towards the mobile AR application. Moreover, it created enjoyable and learner-centered training that could improve learners' motivation and self-confidence in learning the English language.

Suwancharas (2016) investigated the effectiveness of the developed Multimedia using Augmented Reality (AR) and studied the satisfaction of the students who used the developed Multimedia using Augmented Reality (AR). The sample group was 30 students selected by multistage sampling method from undergraduate students in Faculty of Education at Bansomdejchaopraya Rajabhat University in the second semester of the 2014 academic year. The research instruments consisted of the multimedia using Augmented Reality (AR), an English listening skills test, and a

satisfaction questionnaire. The research statistics used in this study were percentage, mean, standard deviation, and t-test. The findings showed that the multimedia using Augmented Reality (AR) for improving undergraduates' English listening skill was effective and students were satisfied with the multimedia at the highest level.

Phatai, Chanpum, and Wattanasura (2018) developed animal planet vocabulary book with Augmented Reality Technology and evaluated the satisfaction of learners towards the developed book. The sample group was 30 kindergarten students at Ban Pa Wah School, Sakon Nakhon province. The research instruments used in this study were animal planet vocabulary book with augmented reality technology and the satisfaction questioonaire. The research statistics used in this study were mean and standard deviation. It was found that the AR book enabled students to understand more about the lessons and the students were satisfied with the tools at the highest level.

In summary, the above studies revealed that the use of AR technology to improve English language ability and increase motivation of learners was effective. However, there has been no study related to the use of AR technology to improve English pronunciation. This study will make use of the AR technology to assist English pronunciation learning and to increase learners' interest in learning English by themselves.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter deals with the research procedures used to examine the use of AR technology to enhance problematic English pronunciation of the English education students at Chiang Mai Rajabhat University. This chapter consists of subsections on research objectives, research design, population and the sample group, research instruments, data collection, and data analysis.

Research Design

This study is a quasi-experimental design, with a single group pre-test, post-test design.

O_1	X	O_2

The symbols above represent that the measurements are taken on the sample group both before (O_1) and after (O_2) receiving the treatment (X)

Population and Sample Group

Population

The population in this study consisted of 119 English education students at Chiang Mai Rajabhat University enrolling in the Phonetics course in the 2019 academic year.

Sample Group

The sample group was selected from the population by applying the cluster sampling method. The sample group was composed of 39 third-year English education students. Moreover, twelve students from the sample group were purposively selected for the interview.

Research Instruments

The instruments for treatment were the pronunciation lessons with the incorporation of the AR technology and a lesson plan. Moreover, the data were further collected using pronunciation ability test, a questionnaire, and interview questions.

The lesson plan, pronunciation test, questionnaire, and interview questions were verified using Index Objective Congruence (IOC) by three language experts. According to Rovinelli and Hambleton (1977), the IOC used to evaluate the items was based on the score range from -1 to +1 as follows.

Congruent = + 1

Questionable = 0

Incongruent = -1

The items that had scores lower than 0.5 were revised, while, the items that had scores higher than or equal to 0.5 were accepted.

1. **The pronunciation lessons with the incorporation of the AR technology**

The instrument for treatment was the pronunciation lessons with an incorporation of the AR technology. They were designed and generated by Augmented Reality (AR) software called ZapWorks. The lessons provided Zapcodes which were codes or AR markers that provided users AR contents by scanning. Zapcodes were scanned by Zappar application which was freely downloaded from *Android* and *iOS*, and the users then were able to experience the AR contents in various formats, such as, images, videos, audios, and so forth. The participants were given opportunities to learn and practice English pronunciation using their smartphones or tablets.

The AR technology-incorporated pronunciation lessons consisted of pronunciation lessons and exercises. The pronunciation lessons were taken from five books which included *English Phonetics and Phonology: a practical course, The Sounds of English, Teaching American English Pronunciation, English Pronunciation in Use: Advanced,* and *Practical English Phonetics.* Only the topics related to English stress and intonation were selected. After that, the same or similar topic from each book was synthesized and divided into eight units as follows.

Unit 1: Introduction to pronunciation and stress

- Introduction to pronunciation
- Features of pronunciation
- Introduction to stress
- Level of stress
- Placement of stress within words

Unit 2: Part of speech and compounding

- Part of speech and stress
- Compounding and stress

Unit 3: Affixation

- Prefix and stress
- Suffix and stress

Unit 4: Specific stress rules

- Numbers and stress
- Abbreviations and stress
- Names and stress
- Shifts of stress

Unit 5: Sentence stress

- Sentence stress
- Special emphasis
- Weak form

Unit 6: Introduction to intonation and intonation patterns

Unit 7: Intonation and discourse in English

Unit 8: Summary

The pronunciation lessons with the incorporation of the AR technology were verified by three experts who were selected based on their expertise including one English instructor for the subject matter and two technology specialists for the multimedia, design, and presentation (see Appendix A for more information). The AR lessons were evaluated using the five-point rating scale from excellent to poor, as shown below.

4.50 – 5.00	Excellent
3.50 – 4.49	Good
2.50 – 3.49	Fair
1.50 – 2.49	Poor
1.00 – 1.49	Very Poor

(Source: Best, 1986)

From the evaluation result, all three experts were satisfied with the pronunciation lessons with the incorporation of AR technology as the overall mean of the evaluation was at "good" level ($\overline{X}$ = 4.47) (see Appendix D, Table A-1 for more information).

2. **Lesson plan**

Lesson plan in this study described a teaching plan of English pronunciation course focusing on stress and intonation for English education students at Chiang Mai Rajabhat University. The time required to complete the lessons was two months (eight weeks). This course aimed that the students were able to produce English stress and intonation correctly and naturally and use the AR application to learn pronunciation by themselves. The teaching procedures integrated English pronunciation teaching and self-study approach with the AR technology. Each lesson consisted of three steps: opening, self-study with AR application, and closing. In the opening step, the teacher informed the students about necessary information, such as, the AR application, time, topic of the lesson, exercises, and evaluation. Moreover, in the first week, the students needed to complete the pre-test. Next, the students studied English pronunciation by themselves using the AR application in the second step. They had two hours to finish the lesson of each week. Finally, in the closing step, the students discussed about the lessons, practiced their pronunciation, and did oral pronunciation exercises with the teacher. Besides, in the last week, the students needed to complete the post-test, the questionnaire, and the structured interview (see Appendix B for more information). In addition, the materials used in learning were smartphones or tablets, earphones, and worksheets. The evaluation result of the lesson plan using the index of item-objective congruence (IOC) indicated that all items in the lesson plan received IOC scores higher than 0.50 which indicated that they were all acceptable (see Appendix D, Table A-2 for more information).

3. **Pronunciation ability test**

The pronunciation ability test in this study was an oral test including the parallel pre-test and post-test. The test consisted of 50 question items related to English stress and intonation. The test included all topics in the lessons to measure students' pronunciation ability in terms of English stress and intonation. The students were asked to pronounce words and sentences aloud using tape recorders and earphones. The evaluation result of the pronunciation ability test using the index of item-objective congruence (IOC) indicated that all items in the pronunciation ability test received IOC scores higher than 0.50 which indicated that they were accepted (see Appendix D, Table A-3 for more information).

4. **Questionnaire**

The questionnaire was used to survey the participants' satisfaction with the use of the AR-incorporated pronunciation lessons to assist English pronunciation learning. It consisted of 15 five-point-rating scale asking the students about their satisfaction towards the use of AR-incorporated pronunciation lessons. The levels were as follows.

Strongly satisfied	=	5
Satisfied	=	4
Neutral	=	3
Dissatisfied	=	2
Strongly dissatisfied	=	1

The evaluation result of the questionnaire using the index of item-objective congruence (IOC) indicated that almost all items received IOC scores higher than the qualified criteria which indicated that they were accepted. There was an item that needed to be revised. However, some items were revised according to the experts' suggestions (see Appendix D, Table A-4 for more information).

5. **Structured interview**

Twelve students were purposively selected for the interview about their satisfaction with the use of AR application. The participants were interviewed after completing the post-test. There were five questions as follows.

1) How do you feel about using the AR application to assist your English pronunciation learning?

2) Do you think your problematic English pronunciation has improved because of the AR application?

3) Do you prefer learning with the teacher in class or applying AR technology to learn language? Why?

4) Have you found some limitations of using the AR application to assist your language learning?

5) What are your suggestions for the improvement of the AR application to help you learn English pronunciation?

The evaluation result of the interview questions using the index of item-objective congruence (IOC) indicated that all items of the interview questions received IOC scores higher than 0.50 which indicated that the interview questions were accepted. However, there was a suggestion to revise Items 3 and 5 (see Appendix D, Table A-3 for more information).

Data Collection

To collect the data, the following steps were undertaken.

1) **Orientation:** The students were introduced to the pronunciation lessons with an integration of AR technology, how to use the AR application, how to take an exercise after the treatment, how to measure their pronunciation ability and satisfaction, and time and place for using the instruments. Moreover, the students were required to install the Zappar application onto their smartphones or tablets. This step took approximately 15-20 minutes.

2) **Before the experiment:** The students took the English pronunciation ability pre-test. They had 20 minutes to finish the test by pronouncing the given words and sentences aloud using tape recorders and earphones. After that, the students sent their voice records to the researcher via e-mail.

3) **During the experiment:** The students were assigned to learn English pronunciation with the AR-incorporated pronunciation lessons once a week for eight weeks. In each week, the students used the Zappar application to learn English pronunciation by themselves. They had two hours to finish a lesson. After that, the

teacher reviewed and discussed about the lesson with them. Furthermore, they are given the opportunities to practice their pronunciation with the teacher before taking an oral exercise. Then, the students were asked to complete an oral exercise one by one with the researcher to check their understanding and progress.

4) **After the experiment:** The students took the English pronunciation ability post-test. They had 20 minutes to finish the test by pronouncing the given words and sentences aloud using tape recorders and earphones. After that, the students sent their voice records to the researcher via e-mail. After that, a questionnaire was administered to investigate their satisfaction levels. Finally, twelve students were purposively selected for the interview to explore their satisfaction with the use of the AR-integrated pronunciation lessons. Each interview lasted about five minutes.

Data analysis

Quantitative data analysis

1) The E1/E2 formula was employed to examine the efficiency of the use of AR-incorporated pronunciation learning to improve English pronunciation based on the efficiency criterion at E1/E2 = 75/75. The data collected from exercises and post-test were calculated for the percentage of the students' mean scores. The E1/E2 formula was as follows (Brahmawong, Netprasoet, & Sinsakun, 1977).

$$\text{Efficiency of process (E1)} = \frac{\sum X}{\frac{N}{A}} \times 100$$

$\sum X$ = Total scores that students gain from doing exercises

N = Number of all the students

A = Total scores of all exercises

$$\text{Efficiency of process (E2)} = \frac{\sum X}{\frac{N}{B}} \times 100$$

$\sum X$ = Total scores that students gain from doing a posttest after using the AR-incorporated pronunciation lessons

N = Number of all the students

B = Total scores of the post-test

2) The mean scores obtained from the pre-test and the post-test were compared using a pair-sample t-test to investigate the improvement of students' pronunciation ability. The statistics used in this part included mean, standard deviation, and t-value.

3) To examine the students' satisfaction, they were assigned to complete the questionnaire. The questionnaire results were calculated to obtain the mean and standard deviation of the questionnaire items, based on the Likert scale questions that rated the satisfaction levels from highest, high, moderate, low, and lowest, yielding a description of the students' satisfaction with the AR application. The students' satisfaction levels were interpreted as follows.

4.50 – 5.00	Highest
3.50 – 4.49	High
2.50 – 3.49	Moderate
1.50 – 2.49	Low
1.00 – 1.49	Lowest

(Source: Best, 1986)

Qualitative data analysis

The qualitative data analysis was conducted with the data obtained from the structured interview. The interview was aimed at finding the students' opinions on the use of AR-incorporated pronunciation lessons to learn English pronunciation. The

students were interviewed both in Thai and English in an attempt to investigate how and in what ways the AR application could help them to improve their problematic English pronunciation. The data was classified into positive and negative opinions, and the results were presented descriptively.

CHAPTER 4

RESULTS AND DATA ANALYSIS

This chapter presents the statistical analysis of the collected data based on the three research objectives. The first section illustrates the efficiency of the developed pronunciation lessons with the incorporation of the Augmented Reality (AR) technology. The second section demonstrates the students' pronunciation improvement after learning with the AR-incorporated pronunciation lessons. The final section presents the students' satisfaction with the pronunciation lessons. The results are presented both quantitatively and qualitatively based on the research objectives as follows:

Section 1 Efficiency of the developed pronunciation lessons with the incorporation of the AR technology

Section 2 Students' pronunciation improvement results

Section 3 Student's satisfaction with the AR-incorporated pronunciation lessons

Section 1 Efficiency of the developed pronunciation lessons with the incorporation of AR technology

To investigate the efficiency of the developed pronunciation lessons with the incorporation of the AR technology, the 39 students were asked to use the AR application to assist their English pronunciation learning and to do the exercises according to the lessons. The efficiency of the AR-incorporated pronunciation lessons is based on the 75/75 efficiency criteria. Table 4.1 summarized the results of the efficiency of the learning process.

Table 4.1 Results of the efficiency of the learning process

Learning Unit	N	$\sum\bar{X}$	Scores during Learning	$\bar{X}$	E1
1	39	10	298	7.64	76.4
2	39	10	304	7.79	77.9
3	39	10	296	7.59	75.9
4	39	10	308	7.9	79
5	39	10	301	7.72	77.2
6	39	10	295	7.56	75.6
7	39	10	293	7.51	75.1
8	39	10	299	7.67	76.7
Total	**39**	**80**	**2394**	**61.38**	**76.73**

According to Table 4.1, the efficiency of the learning process (E1) of the AR-incorporated pronunciation lessons was at 76.73. The efficiency of leaning process of each unit was also higher than the 75/75 efficiency criteria.

Table 4.2 Efficiency of the AR-incorporated pronunciation lessons according to the 75/75 criteria

Scores	N	$\bar{X}$	E1/E2
Scores during learning (Total score = 80)	39	61.38	E1 = 76.73
Post Learning scores (Total score = 50)	39	38.05	E2 = 76.10

Table 4.2 showed the efficiency results of the pronunciation lessons with the incorporation of AR technology. Efficiency of the lessons during the learning process (E1) was at 76.73 and the efficiency of performance (E2) was at 76.10, so the efficiency analysis results of the pronunciation lessons with the incorporation of the AR technology indicated that both the exercise scores and the post-test scores met the 75/75 efficiency criteria. As a result, it can be said that the developed pronunciation lessons with the incorporation of the AR technology is efficient and can be utilized or applied to teach and learn English pronunciation.

Section 2 Students' pronunciation ability improvement results

In this part, the paired-sample t-test was conducted to compare the students' pronunciation scores before and after learning with pronunciation lessons with the incorporation of the AR technology. The oral pre-test and post-test were adopted to measure their pronunciation ability. The students were asked to pronounce words and sentences aloud using tape recorders and earphones. The tests covered English stress and intonation. The results of the analysis are shown in the following table.

Table 4.3 Comparison of pronunciation pre-test and post-test scores

Score	N	Total scores	Min	Max	M	S.D.	t	Sig. (2-tailed)
Pre	39	50	9	29	19.92	5.00	-15.148*	0.00
Post	39	50	30	47	38.05	5.20		

* significant at the .05 level

According to table 4.3, it was found that there was a significant difference in the scores before and after learning with the AR-incorporated pronunciation lessons. As presented in the table, with the total score of 50, the mean scores of the pronunciation pre-test were 19.92 with the standard deviation of 5.00, while those of the post-test increased to 38.05 with the standard deviation of 5.20. The t-value was -15.148 which indicated a statistically significant difference between the pre-test and post-test mean scores at the .05 level. The minimum scores of the students rose from 9 in the pre-test to become 30 in the post-test, while the maximum score of the students rose from 29 in the pre-test to become 47 in the post-test. These results suggested that the developed

pronunciation lessons with the incorporation of the AR technology could help students to improve their English pronunciation. Additionally, this finding confirmed the research hypothesis that the post pronunciation ability of the students learning with the pronunciation lessons with the incorporation of the AR technology was higher than that of the pre-learning counterpart ability.

Section 3 Student's satisfaction with the AR-incorporated pronunciation lessons

To explore student's satisfaction with the AR-incorporated pronunciation lessons, the students were required to complete the questionnaire by rating each item on the five-point rating scale from strongly satisfied, satisfied, neutral, dissatisfied, to strongly dissatisfied. Students' self-rating scores from the questionnaire were analyzed and calculated for the mean and standard deviation and interpreted into five levels. The results were shown in Table 4.4.

Table 4.4 Student's satisfaction levels with the AR-incorporated pronunciation lessons

Questionnaire items	$\bar{X}$	S.D.	Level of satisfaction
1. Learning English pronunciation using the AR application can help me understand the lessons better.	4.48	0.51	High
2. The AR application enables me to learn English pronunciation systematically.	4.31	0.69	High
3. The AR application can support self-directed learning.	4.41	0.72	High
4. I believe that the AR application can help me to increase academic achievement (e.g. grades).	4.26	0.75	High
5. The AR application can enrich the learning contents.	4.33	0.62	High
6. The information provided by the AR application is easy to understand and follow.	4.38	0.71	High
7. I prefer learning with the AR application to the traditional way of learning.	4.23	0.71	High
8. I feel more comfortable to listen and repeat English words and sentences in front of smartphones or tablets.	4.21	0.73	High
9. The sounds, pictures, and videos in the application make the tool more interesting.	4.23	0.81	High

Table 4.4 (Cont.)

Questionnaire items (Cont.)	$\bar{X}$	S.D.	Level of satisfaction
10. The AR application can increase my motivation in learning.	4.23	0.78	High
11. The AR application is suitable for my ability.	4.28	0.65	High
12. The AR application allows me to practice at my convenience.	4.46	0.60	High
13. It is easy to read the information on the smart phone screen of the AR application.	4.26	0.82	High
14. I want to learn with the AR application in other subjects.	4.13	0.68	High
15. The AR application is an effective tool for teaching and learning English pronunciation.	4.38	0.75	High
Total	**4.31**	**0.70**	**High**

According to Table 4.4, the overall mean of the students' satisfaction with learning English pronunciation through the AR-incorporated pronunciation lessons was at a high level ($\bar{X}$ = 4.31, S.D. = 0.70). Moreover, each item in the questionnaire was rated at a high level. Although all items were rated at a high level, the mean score of each item was slightly different. When the items were taken into consideration, it was revealed that the item with the highest mean of satisfaction level was item 1 ($\bar{X}$ = 4.48, S.D. = 0.51). They believed that learning by using the AR application to assist learning English pronunciation could help them to understand the lessons better. Additionally, the item with the second highest mean of satisfaction level was item 12 ($\bar{X}$ = 4.46, S.D. = 0.60). The students responded that the AR application allowed them to practice at their convenience. On the other hand, the students had the lowest level of satisfaction with item 14 ($\bar{X}$ = 4.13, S.D. = 0.68). They had the lowest satisfaction toward the idea of using this kind of AR application in other subjects.

Furthermore, an interview with the students revealed that they expressed both positive and negative feelings toward the AR-incorporated pronunciation lessons. From the interview, it was found that all students had positive feelings with the AR-incorporated pronunciation lessons. They were satisfied with the instrument because it was interesting and exciting. It was easy and convenient to use, so they could easily

access to the learning contents and resources. The students also believed that the AR-incorporated pronunciation lessons could help them to improve their problematic English pronunciation because it enabled them to practice their English pronunciation repeatedly. They could manage their learning pace due to the flexibility of the AR lessons. Moreover, the AR-incorporated pronunciation lessons enabled shy students to practice their pronunciation privately. It provided various multimedia which could attract the students' attention and motivate them to learn more as well as enable them to master the lessons better, such as native speakers' sounds, videos, and pictures. These native speakers' sounds in the lessons helped the students to know how to pronounce the English words and sentences correctly. Some of them replied that they were more confident to pronounce English words and sentences after learning with the AR-incorporated pronunciation lessons. In addition, the summaries of English pronunciation rules in the lessons helped them to understand the lessons easier and faster.

On the other hand, there were some limitations that brought about negative feelings of the students. The students revealed that to use the AR application, a good internet signal was needed because it was difficult to scan the AR markers when an internet connection was unstable. Furthermore, the lessons on the screen became smaller when turning the smartphone out of the AR markers (Zapcodes), so the students needed to hold the smartphone all the time. Some students disclosed that the lessons could be learned only on smartphones and tablets which were small, so it was more difficult to read than on paper and using these devices to learn for a long time could ruin their eyesight. Additionally, there was a limitation of the contents that the students needed more examples related to daily situations in the lessons. Some students expressed that they preferred learning with teachers to learning with AR application because they could ask teachers when they did not understand and teachers could correct their pronunciation immediately. According to these limitations, there were some suggestions from the students to develop the AR-incorporated pronunciation lessons. The students suggested that it would be preferable if they could learn English pronunciation with the AR application in the offline mode. The lessons on the screen should be fit and big enough with the smartphone screen and should not become smaller when turning the smartphone camera away from the AR marker. Moreover, the lessons

should provide more examples related to daily life situations, so it would be easier for them to understand and remember the lessons. There should be a pronunciation checker provided in the AR lessons for checking their English pronunciation as well. Finally, the majority of students revealed that they preferred the combination of learning with teachers and learning with AR application. They believed that learning with teachers in class was still necessary at present, and they could use the AR-incorporated pronunciation lessons to revise the lessons and practice at home. They agreed that the pronunciation lessons with the incorporation of AR technology was an effective tool to assist English pronunciation learning, but it should be used as a part of the learning process.

To sum up, the pronunciation lessons with the incorporation of AR technology are an efficient tool that could help the students to improve their pronunciation ability significantly. The efficiency of the AR-incorporated pronunciation lessons was 76.73/76.10, which was higher than the predetermined 75/75 efficiency criteria. Furthermore, there was a statistically significant difference between the mean scores students obtained from the pronunciation pre-test and post-test at a significance level of .05. The students' post-test scores after learning with the AR-incorporated pronunciation lessons were higher than those of the pre-test scores. In addition, the students were satisfied with the developed AR-incorporated pronunciation lessons. They believed that the AR-incorporated pronunciation lessons could help them to improve their pronunciation ability. They became motivated, actively engaged and interested in the lessons enriched by AR technology. Additionally, they were more confident in their English pronunciation. They had positive feelings towards the AR-incorporated pronunciation lessons due to its design and flexibility. There were various multimedia that could help to attract them, and they could manage their learning pace by their own. It was portable and easy to use. Although most students believed that integrating AR technology to the English pronunciation lessons was beneficial for learners since they could revise the lessons and practice after class, they still needed to learn with teachers in class. However, there were some limitations that brought about some negative feelings of the students, such as, an unstable internet connection, technical difficulties in scanning the markers and maintaining the display size, and limited examples.

CHAPTER 5

CONCLUSION, DISCUSSION, LIMITATIONS AND RECOMMENDATIONS

Conclusions

The conclusion of the findings is presented based on the research objectives as follows:

1. The efficiency (E1/E2) of pronunciation lessons with the incorporation of AR technology was at 76.73/76.10, which was higher than the specified 75/75 criteria.

2. The students' pronunciation ability improved significantly because there was a significant increase of the mean score after learning with the developed pronunciation lessons with the incorporation of AR technology at the .05 level.

3. The students were satisfied with the AR-incorporated pronunciation lessons at a high level. Additionally, it was found that the students expressed both positive and negative opinions on the developed lessons.

Discussion

The findings have some important issues to be discussed. The discussions begins with the efficiency of the of the pronunciation lessons with the incorporation of the AR technology and the students' pronunciation improvement. Then, the students' satisfaction with the AR-incorporated pronunciation lessons is discussed.

According the results, the efficiency of the pronunciation lessons with the incorporation of AR technology for the third-year English teacher students at Chiang Mai Rajabhat University, the E1/E2, was 76.73/76.1, which was higher than the designated criteria of 75/75, indicating that the pronunciation lessons with the incorporation of AR technology were efficient for being a tool to assist English pronunciation teaching and learning. The researcher applied some pronunciation instruction strategies reviewed in Chapter 2 (Scarcella & Oxford, 1994; Lin, Fan &

Chen, 1995; Cheng, 1998). Initially, the students were instructed and explained in some important parts, then an assisted instrument was provided to students to learn and practice pronunciation by themselves. The instrument was the developed AR lessons which was a kind of computer technology. In the AR lessons, there were drawing pitch lines and arrows that could help the students to understand more clearly about pitch changes in the English language. Before administering the pronunciation lessons with the incorporation of AR technology to the students, it was verified by the experts and revised in terms of contents and design. The researcher gave the students guidance on how to use the tool to assist learning. Finally, students' progress and understanding to the lessons were assessed by using the pronunciation exercises and pronunciation ability test. After using the tool, the students' scores had increased substantially. It could be seen from the students' achievement as a result of the AR-incorporated pronunciation lessons. It showed that there was a statistically significant difference in the mean scores before and after learning with the AR-incorporated pronunciation lessons at the .05 level. The finding was consistent with the studies of Küçük, Yılmaz and Göktaş (2014), Phatai, Chanpum, and Wattanasura (2018) and Suwancharas (2016). Their findings revealed that AR technology could positively affect the students' learning achievement. The important factor which resulted in the successful learning was the use of AR technology to assist English pronunciation instruction. The design of AR lessons facilitated learning by providing learners flexibility. It was also attractive and interesting. Furthermore, AR technology can increase information accessibility and interactivity (Bonner and Reinders, 2018; Diegmann, Schmidt-Kraepelin, Eynden, & Basten, 2015).

According to the result, the students' satisfaction with the AR-incorporated pronunciation lessons from the questionnaire and interview revealed that the students were satisfied with the use of AR-incorporated pronunciation lessons to learn English pronunciation. This finding confirms those of the previous studies (Gündoğmug, Orhan & Sahin, 2016; Hsieh, Kuo & Lin, 2014; Küçük, Yılmaz, & Göktaş, 2014; Phatai, Chanpum &Wattanasura, 2018; Suwancharas, 2016) that the participants were satisfied with the use of AR technology to improve English language skills. Moreover, it could increase students' motivation which was an important factor that could affect learners' pronunciation. With the use of AR technology, the students expressed that the

developed AR lessons had various functions that could motivate and attract them to learn more, such as, pictures, videos, sounds, colors of a screen, and alphabet colors. It maintained a high level of enjoyment and engagement during the learning process. Similarly, it was believed that AR technology could increase motivation, attention, concentration, and satisfaction of learners (Diegmann et al., 2015). From the interview, the students revealed that AR technology enabled them to increase their confidence in speaking English. They had opportunities to expose to the English language since they could access to the learning media, contents, and resources easily. As AR technology could help to promote the autonomous skill of learners (Bonner and Reinders, 2018; Craig & McAleer, 2011; Diegmann et al., 2015; Yuen, Yaoyuneyong, & Johnson, 2011), the students in this study were able to manage their learning by themselves. They also had direct experience because of the authentic media provided in the AR application, such as, videos and native speaker sounds. Additionally, it was believed that AR technology helped learners to understand things easier (Diegmann et al., 2015). The contents of the lessons were also easy to access and learners could learn according to their abilities and proficiencies. The lessons were linked to other learning resources, making it more convenient to discover new knowledge. Besides, the AR application was convenient and easy to use. These reasons made the students satisfied with the AR-incorporated pronunciation lessons. However, some students found several problems while learning with the AR application. The internet connection, technical difficulties in scanning the markers and maintaining the display size were the main challenges that should be addressed. For instance, the internet connection in some places was still low and unstable which affected accessibility of the AR lessons. The internet connection and condition of the smartphones or tablets also caused the difficulty in scanning the markers. Furthermore, due to the problem of the software, the students needed to hold the smartphones all the time; otherwise, the lessons on the screen became small. Mostly, the problems were from the software itself; therefore, to solve the problems, the application and software used to produce AR lessons need to be changed.

Overall, the pronunciation lessons with the incorporation of AR technology were appropriate to use as an assisted tool to learn English pronunciation. Besides, the students' satisfaction with the AR-incorporated pronunciation lessons could positively affect the improvement of the English pronunciation of the students.

Limitations

This study has discovered that the pronunciation lessons with the incorporation of AR technology was proved to be efficient in helping the third-year English teacher students at Chiang Mai Rajabhat University to improve their English pronunciation, including stress and intonation. However, there were two limitations that might have affected the research results.

1. The time used for this study was a limitation of the study. The time for the experiment was only two hours per week within two months. It could be an important factor because the research conducted with a different length of time could yield different findings.

2. The participants in this study had various levels of phonetic ability including high, medium, and low. This difference might affect the results of the study.

Recommendations

Based on the results of this study, some recommendations from this research are as follows.

Pedagogical recommendations

1. This AR-incorporated pronunciation lessons can be used as a tool or resource for stimulating and encouraging the students to improve their pronunciation. It should be a supplementary tool for learning enhancement and practicing outside the classroom. Furthermore, teachers should facilitate, assist, and give advice to students in using the tool.

2. For those wishing or wanting to use the results or methodology of this research, it is advisable that there be some adjustment and/or adaptation to suit their particular context.

Recommendations for further studies

1. AR technology should be adopted to use with other groups of participants with a longer implementation period.

2. Future researchers may integrate the AR technology to improve students in other English skills.

3. Further studies should be conducted by using the control and experimental groups to obtain more validity of the results.

4. Other AR platforms may be used to develop lessons. Additionally, the availability of good and stable equipment and network is required.

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APPENDICES

Appendix A

List of Experts

No.	Name-Surname	Position	Instruments
1	Asst. Prof. Dr. Nutreutai Arunsirot	English lecturer at Chiang Mai Rajabhat University	- Lesson plan - Pronunciation test - Questionnaire - Interview questions - AR-incorporated pronunciation lessons (contents)
2	Asst. Prof. Dr. Dusadee Rangseechatchawan	English lecturer at Chiang Mai Rajabhat University	- Lesson plan - Pronunciation test - Questionnaire - Interview questions
3	Asst. Prof. Salila Sriratanaban	English lecturer at Chiang Mai Rajabhat University	- Lesson plan - Pronunciation test - Questionnaire - Interview questions
4	Dr. Tiwawan Takran	Technology lecturer at Chiang Mai Rajabhat University	AR-incorporated pronunciation lessons (multimedia, design, and presentation)
5	Ajarn Jarunee Patharawongthana	Technology lecturer at Far Eastern University	AR-incorporated pronunciation lessons (multimedia, design, and presentation)

An Example of Invitation Letters for Verifying the Instruments

ที่ อว. ๐๖๑๒.๑๔.๐๑/ว.๒๑๘

บัณฑิตวิทยาลัย
มหาวิทยาลัยราชภัฏเชียงใหม่
๒๐๒ ถนนช้างเผือก อ.เมือง
จ.เชียงใหม่ ๕๐๓๐๐

๒ มีนาคม ๒๕๖๓

เรื่อง ขอความอนุเคราะห์เป็นผู้เชี่ยวชาญตรวจเครื่องมือในการทำการค้นคว้าอิสระ

เรียน อาจารย์ ดร.ทิวาวัลย์ ต๊ะการ

สิ่งที่ส่งมาด้วย เครื่องมือในการทำการค้นคว้าอิสระ จำนวน ๑ ชุด

ด้วยบัณฑิตวิทยาลัย มหาวิทยาลัยราชภัฏเชียงใหม่ ได้อนุมัติให้ **นางสาวพิชชาพร โอภาศ** นักศึกษาระดับปริญญาโทหลักสูตรศิลปศาสตรมหาบัณฑิต สาขาวิชาภาษาอังกฤษศึกษา การทำการค้นคว้าอิสระเรื่อง **"การใช้เทคโนโลยีความจริงเสริมในการพัฒนาการออกเสียงภาษาอังกฤษของนักศึกษาครุศาสตร์สาขาวิชาภาษาอังกฤษ มหาวิทยาลัยราชภัฏเชียงใหม่"** โดยมี ผู้ช่วยศาสตราจารย์ ดร.เฉลิมชัย ไชยชมภู เป็นอาจารย์ที่ปรึกษาการค้นคว้าอิสระ

บัณฑิตวิทยาลัย เห็นว่าท่านเป็นผู้มีประสบการณ์เกี่ยวกับเรื่องดังกล่าวเป็นอย่างดี โดยนักศึกษาได้ประสานกับท่านแล้ว บัณฑิตวิทยาลัย จึงใคร่ขอความอนุเคราะห์จากท่านในการตรวจและให้ความเห็นเกี่ยวกับเครื่องมือในการทำการค้นคว้าอิสระดังเอกสารที่แนบมาพร้อมนี้

จึงเรียนมาเพื่อโปรดพิจารณา และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

(ผู้ช่วยศาสตราจารย์ ดร.กมลณัฏฐ์ พลวัน)
คณบดีบัณฑิตวิทยาลัย
มหาวิทยาลัยราชภัฏเชียงใหม่

บัณฑิตวิทยาลัย
โทรศัพท์. ๐๕๓-๘๘๕๙๙๙
โทรสาร. ๐๕๓-๘๘๕๙๙๙

Appendix B

Research instruments

The AR-incorporated pronunciation lessons: Zapcodes (AR triggers)
Lesson Plan
Exercises
Pronunciation pre-test and post- test
Questionnaire
Interview questions

ZAPCODES (AR Triggers)

ENGLISH PRONUNCIATION: STRESS AND INTONATION

Unit 1:

- Introduction
- Features of pronunciation
- Introduction to stress
- Level of stress
- Placement of stress within a word

Unit 2:

- Stress and part of speech

- Compounding and stress placement

Unit 3:

- Affixation and stress placement

- Examples of suffixation

Unit 4:

- Abbreviations/Acronym
- Numbers with the "teen" and "ty"
- Names
- Telephone Numbers
- Shifts of Stress

Unit 5:

- Sentence stress
- Special emphasis

- Weak forms

Unit 6:

- Introduction to intonation
- Intonation patterns

Unit 7:

- Intonation and discourse in English

Unit 8: Summary

LESSON PLAN

Course: English Pronunciation (Stress and Intonation)
University: Chiang Mai Rajabhat University
Faculty: Education (English Major)
Allocation Time: 2 hours (Saturday, 10.00-12.00 A.M.)

Objectives:

1. Students are able to produce English stress and intonation correctly and naturally.
2. Students are able to use the AR application to learn pronunciation by themselves.

Instructional Media:

1. The AR application (Zappar)
2. Worksheets

Procedures:

Week	Procedures	Time	Activities	Materials
1	Opening	40 minutes	1. The teacher introduces herself to the class and checks the participants. 2. The students are asked to complete the pronunciation pre-test 3. The teacher introduces how to download the application and how to use it.	Smartphone/tablet Earphone/headphone Worksheets
	Self-study with AR application	1.30 – 2 hrs.	The teacher lets students use the AR application to learn English pronunciation by themselves. Content: **Introduction to pronunciation and stress** - Features of pronunciation - What is stress? - Why stress is necessary in English pronunciation? - Level of stress - Placement of word stress within words	Smartphone/tablet Earphone/headphone Worksheets

Week	Procedures	Time	Activities	Materials
1	Closing	30 minutes	1. After the students finish learning English pronunciation by using AR application, the teacher reviews and discuss about the lessons with the students. 2. Before taking an oral exercise, the students are given the opportunities to practice their pronunciation according to the lessons of a particular week with the teacher. 3. The students are assigned to complete an oral exercise one by one with the teacher to check their understanding. 4. The teacher tells students what topic they will learn next time.	Worksheets
2	Opening	10 minutes	The students are checked and informed about the time and the lesson.	-
	Self-study with AR application	1.30 – 2 hrs.	The teacher lets students use the AR application to learn English pronunciation by themselves. Content: **Part of speech and compounding** - Stress and part of speech - Compounding and stress placement	Smartphone/tablet Earphone/headphone Worksheets
	Closing	30 minutes	1. After the students finish learning English pronunciation by using AR application, the teacher reviews and discuss about the lessons with the students.	Worksheets

Week	Procedures	Time	Activities	Materials
2	Closing	30 minutes	2. Before taking an oral exercise, the students are given the opportunities to practice their pronunciation according to the lessons of a particular week with the teacher. 3. The students are assigned to complete an oral exercise one by one with the teacher to check their understanding. 4. The teacher tells students what topic they will learn next time.	Worksheets
3	Opening	10 minutes	The students are checked and informed about the time and the lesson.	-
	Self-study with AR application	1.30 – 2 hrs.	The teacher lets students use the AR application to learn English pronunciation by themselves. Content: **Affixation**	Smartphone/tablet Earphone/headphone Worksheets
	Closing	30 minutes	1. After the students finish learning English pronunciation by using AR application, the teacher reviews and discuss about the lessons with the students. 2. Before taking an oral exercise, the students are given the opportunities to practice their pronunciation according to the lessons of a particular week with the teacher. 3. The students are assigned to complete an oral exercise one by one with the teacher to check their understanding.	Worksheets

Week	Procedures	Time	Activities	Materials
3	Closing	30 minutes	4. The teacher tells students what topic they will learn next time.	-
4	Opening	10 minutes	The students are checked and informed about the time and the lesson.	Smartphone/tablet Earphone/headphone Worksheets
	Self-study with AR application	1.30 – 2 hrs.	The teacher lets students use the AR application to learn English pronunciation by themselves. Content : **Specific stress rules** - Numbers and stress - Abbreviations and stress - Names and stress - Shifts of stress	
	Closing	30 minutes	1. After the students finish learning English pronunciation by using AR application, the teacher reviews and discuss about the lessons with the students. 2. Before taking an oral exercise, the students are given the opportunities to practice their pronunciation according to the lessons of a particular week with the teacher. 3. The students are assigned to complete an oral exercise one by one with the teacher to check their understanding. 4. The teacher tells students what topic they will learn next time.	-
5	Opening	10 minutes	The students are checked and informed about the time and the lesson.	-

Week	Procedures	Time	Activities	Materials
5	Self-study with AR application	1.30 – 2 hrs.	The teacher lets students use the AR application to learn English pronunciation by themselves. Content: **Sentence stress** - Sentence Stress - Special emphasis - Weak form	Smartphone/tablet Earphone/headphone Worksheets
	Closing	30 minutes	1. After the students finish learning English pronunciation by using AR application, the teacher reviews and discuss about the lessons with the students. 2. Before taking an oral exercise, the students are given the opportunities to practice their pronunciation according to the lessons of a particular week with the teacher. 3. The students are assigned to complete an oral exercise one by one with the teacher to check their understanding. 4. The teacher tells students what topic they will learn next time.	Worksheets
6	Opening	10 minutes	The students are checked and informed about the time and the lesson.	-
	Self-study with AR application	1.30 – 2 hrs.	1. The teacher lets students use the AR application to learn English pronunciation by themselves. Content: **Introduction to intonation and intonation patterns**	Smartphone/tablet Earphone/headphone Worksheets

Week	Procedures	Time	Activities	Materials
6	Closing	30 minutes	1. After the students finish learning English pronunciation by using AR application, the teacher reviews and discuss about the lessons with the students. 2. Before taking an oral exercise, the students are given the opportunities to practice their pronunciation according to the lessons of a particular week with the teacher. 3. The students are assigned to complete an oral exercise one by one with the teacher to check their understanding. 4. The teacher tells students what topic they will learn next time.	Worksheets
7	Opening	10 minutes	The students are checked and informed about the time and the lesson.	-
	Self-study with AR application	1.30 – 2 hrs.	The teacher lets students use the AR application to learn English pronunciation by themselves. Content: **Intonation and discourse in Englis**h 1. After the students finish learning English pronunciation by using AR application, the teacher reviews and discuss about the lessons with the students. 2. Before taking an oral exercise, the students are given the opportunities to practice their pronunciation according to the lessons of a particular week with the teacher.	Smartphone/tablet Earphone/headphone Worksheets

Week	Procedures	Time	Activities	Materials
7	Closing	30 minutes	3. The students are assigned to complete an oral exercise one by one with the teacher to check their understanding. 4. The teacher tells students what topic they will learn next time.	Worksheets
8	Opening	10 minutes	The students are checked and informed about the time and the lesson.	-
	Self-study with AR application	1.30 – 2 hrs.	The teacher lets students use the AR application to learn English pronunciation by themselves. Content: **Summary**	Smartphone/tablet Earphone/headphone Worksheets
	Closing	1 hr.	1. After the students finish learning English pronunciation by using AR application, the teacher reviews and discuss about the lessons with the students. 2. Before taking an oral exercise, the students are given the opportunities to practice their pronunciation according to the lessons of a particular week with the teacher. 3. The students are assigned to complete an oral exercise one by one with the teacher to check their understanding. 4. The pronunciation post-test and a questionnaire are administered to the students. 5. Twelve students are selected randomly for the interview	Smartphone/tablet Earphone/headphone Worksheets

EXERCISES

Unit 1
Exercise: Please read the given words out loud.

1. remember
2. balloon
3. command
4. bulletin
5. measure
6. elevator
7. engineer
8. lemonade
9. understand
10. architect

Unit 2
Exercise: Please read the given words out loud.

1. addict (v.)
2. decrease (n.)
3. object (n.)
4. export (v.)
5. record (v.)
6. baby-sitter
7. orange juice
8. newspaper
9. whatsoever
10. plastic card

Unit 3
Exercise: Please read the given words out loud.

1. disagree
2. recycle
3. bilingual
4. journalese
5. refugee
6. reliable
7. interesting
8. invitation
9. politician
10. photography

Unit 4
Exercise: Please read the given words out loud.

1. USA
2. PhD
3. ninety
4. fifty
5. South Africa
6. New York
7. first class
8. sixteen candles
9. 081-4495682
10. cute young girl

Unit 5
Exercise: Please read the given words, phrases, and sentences out loud.

1. a book
2. on the table
3. my hat
4. Are you going to school?
5. Thailand is a country in Asia.
6. The dog chased a cat in the garden.
7. Where is she going?
8. It was his car. (not hers)
9. It is under the desk. (not on the table)
10. He gave it to me. (not you)

Unit 6
Exercise: Please read the given sentences out loud.

1. He is a doctor.
2. Close the window.
3. Be careful.
4. How can you do that?
5. Was she at home?
6. You ate twenty hot dogs?
7. He is feeling better, isn't he?
8. She speaks French, but not Spanish.
9. Would you like cake or pie?
10. Will you come if I drive you?

Unit 7
Exercise: Please read the given sentences out loud.

1. A: She used to work in Wollongong.
   B: Where?

2. A: I'm playing a VR game.
   B: Pardon?

3. A: I bought Chris a rabbit.
   B: You did what?

4. A: She passed her driving test.
   B: I'm sorry?

5. A: Kathy is getting married again.
   B: She's getting married again.

6. A: Dan got the job!
   B: Great!

7. A: Sounds really good, doesn't it?
   B: Fantastic!

8. A: It only cost me 100 baht.
   B: Really? (I'm surprised.)

9. A: It only cost me 100 baht.
   B: Really? (I'm not sure I believe you.)

10. A: I'm flying to London tomorrow.
    B: What did you say?

Unit 8
Exercise: Please read the given words, phrases, and sentences out loud.

1. celebrate
2. discount (n.)
3. post office
4. bathroom
5. enginee
6. She bought a new sweater.
7. Listen to me.
8. Will you go with us?
9. We went to Paris, Brussels, and London.
10. Lovely day, isn't it?

PRONUNCIATION TEST (STRESS AND INTONATION)

Instruction: Please read the given words and sentences out loud.

1. empire
2. dessert
3. command
4. postpone
5. calendar
6. elevator
7. entertain
8. agriculture
9. nevertheless
10. determine
11. I always buy **produce** at the market.
12. His daughter was a drug **addict.**
13. They **conflic**t with each other again.
14. They **object** to leave early.
15. A change is resulting in a **decrease**.
16. bathroom, ballroom, big room
17. notebook, new book
18. bus station, gas station, large station
19. We live in the white house. The president lives in the White House.
20. forecast
21. journalese
22. advantageous
23. reasonable
24. possible, possibility
25. punish, punishment
26. mystery, mysterious
27. democrat, democracy, democratic
28. photo, photograph, photographer, photography
29. electric, electrical, electricity, electrician
30. CNN, USA, PhD, FBI, UCLA
31. New York, South Africa, Canada
32. sixteen, sixty, nineteen, ninety
33. My number is 089-4853134.
34. seventeen candles, first class ticket
35. big black eyes, cute young girl
36. Thailand is a country in Asia.
37. The dog chased a cat in the garden.
38. Shut the door.
39. He is feeling better, isn’t he?
40. Who are you?
41. What do you want to do?
42. Do you want to go home?
43. Was she at home?
44. They have ten children?
45. He is at the hospital?
46. Lovely day, isn’t it?
47. Would you like cake or pie?
48. I must buy coffee, not tea.
49. Will you come if I drive you?
50. He bought apples, peaches, pears, and oranges.

QUESTIONNAIRE

This questionnaire is used to survey the students' satisfaction with the use of the AR application to assist English pronunciation learning.

Instruction: Please check (✓) the extent you agree with the following statements, according to the following criteria:

Strongly satisfied = 5
Satisfied = 4
Neutral = 3
Dissatisfied = 2
Strongly dissatisfied = 1

Statements	5	4	3	2	1
1. Learning English pronunciation using the AR application can help me understand lessons better.					
2. The AR application enables me to learn English pronunciation systematically.					
3. The AR application can support self-directed learning.					
4. I believe that the AR application can help me to increase academic achievement (e.g. grades).					
5. The AR application can enrich the learning contents.					
6. The information provided by the AR application is easy to understand and follow.					
7. I prefer learning with the AR application to the traditional way of learning.					
8. I feel more comfortable to listen and repeat English words and sentences in front of smartphones or tablets.					
9. The sounds, pictures, and videos in the application make the tool more interesting.					
10. The AR application can increase my motivation in learning.					
11. The AR application is suitable for my ability.					
12. The AR application allows me to practice at my convenience.					
13. It is easy to read the information on the smart phone screen of the AR application.					
14. I want to learn with the AR application in other subjects.					
15. The AR application is an effective tool for teaching and learning English pronunciation.					

Suggestion:
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INTERVIEW QUESTIONS

This structured interview is used to investigate the students' satisfaction with the use of the AR application to assist English pronunciation learning.

Instruction: Please answer the following questions.

1. How do you feel about using the AR application to assist your English pronunciation learning?

2. Do you think your problematic English pronunciation has improved because of the AR application?

3. Do you prefer learning with the teacher in class or applying AR technology to learn language? Why?

4. Have you found some limitations of using the AR application to assist your language learning?

5. What are your suggestions for the improvement of the AR application to help you learn English pronunciation?

Appendix C

Evaluation forms of the AR-incorporated pronunciation lessons
Evaluation form of the lesson plan
Evaluation form of pronunciation tests
Evaluation form of the questionnaire
Evaluation form of interview questions

Evaluation Form of the AR-Incorporated Pronunciation Lessons

(Content and Language Evaluation)

Expert's name: …….

Instruction: Please rate the following elements of the AR-incorporated pronunciation lessons, according to the following criteria:

Excellent = 5
Good = 4
Fair = 3
Poor = 2
Very Poor = 1

Evaluation lists	5	4	3	2	1
Content					
1. Congruence of contents and objectives					
2. Subdivision of contents					
3. Sequencing of contents					
4. Continuity of contents					
5. Correctness of contents					
6. Appropriateness of contents					
7. Interestedness of contents					
Language Use					
1. Appropriate and correct language use					
2. Clarity of language					

Suggestion

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Signature ……..

(…….)

Evaluation Form of the AR-Incorporated Pronunciation Lessons
(Multimedia, Design, and Presentation Evaluation)

Expert's name: …….

Instruction: Please rate the following elements of the AR-incorporated pronunciation lessons, according to the following criteria:

Excellent = 5
Good = 4
Fair = 3
Poor = 2
Very Poor = 1

Evaluation lists	5	4	3	2	1
Multimedia, Design, and Presentation					
1. Beautiful and interesting presentation					
2. Appropriateness of pictures, videos, and sounds					
3. Correctness and clarity of sounds					
4. Background song					
5. Text quality					
6. Text and background colors					
7. Place of button and sign					
8. Length of each lesson					
9. User-friendly organization of the lessons					
10. Overall design					

Suggestion
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Signature ……..
(…….……)

Index Objective Congruence (IOC) of the Lesson Plan

Expert's name: …….

Instruction: Please rate the following elements of the lesson plan, according to the degree of index of item-objective congruence.

-1 = incongruent 0 = questionable or unclear 1 = congruent

Items	IOC Values			Comments
	-1	0	1	
Lesson Layout and Design				
1. The layout and design of the lesson is appropriate and clear.				
2. The layout and design of the lesson is organized effectively.				
Objectives				
3. The objectives are realistic, appropriate, and achievable for the lesson and time allocation.				
4. The objectives are relevant and consistent with the concept of the lesson.				
Stages and activities				
5. The activities are relevant to the stages in the framework of English pronunciation in terms of stress and intonation.				
6. The activities are relevant to the lesson objectives.				
7. Time is appropriately allocated to each stage.				
Procedures				
8. The procedure is in logical sequence.				
9. The procedure is clear and effective.				
Materials				
10. Materials are appropriate for the lesson.				
11. Materials are suitable for the students' ability				
12. Materials are interesting, motivating, and understandable				

Suggestion

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Signature ……..

(…….……)

Index Objective Congruence (IOC) of the Pronunciation Pre-test and Post-test

Expert's name: …….

Instruction: Please rate the following elements of the pronunciation pre-test and post-test, according to the degree of index of item-objective congruence.

-1 = incongruent 0 = questionable or unclear 1 = congruent

Pronunciation Pre-test and Post-test	IOC Values			Comments
	-1	0	1	
Placement of word stress within a word				
1. empire				
2. dessert				
3. command				
4. postpone				
5. calendar				
6. elevator				
7. entertain				
8. agriculture				
9. nevertheless				
10. determine				
Stress and parts of speech				
11. I always buy produce at the market.				
12. His daughter was a drug addict.				
13. They conflict with each other again.				
14. They object to leaving early.				
15. A change resulting in a decrease.				
Compounding and stress placement				
16. bathroom, ballroom, big room				
17. notebook, new book				
18. bus station, gas station, large station				
19. We live in the white house. The president lives in the White House.				
Affixation and stress placement				
20. forecast				
21. journalese				
22. advantageous				
23. reasonable				
24. possible, possibility				
25. punish, punishment				
26. mystery, mysterious				
27. democrat, democracy, democratic				
28. photo, photograph, photographer, photography				
29. electric, electrical, electricity, electrician				
Additional rules for word stress				
30. CNN, USA, PhD, FBI, UCLA				
31. New York, South Africa, Canada				

32. sixteen, sixty, nineteen, ninety				
33. My number is 089-4853134.				
34. seventeen candles, first class ticket				
35. big black eyes, cute young girl				
Sentence stress and intonation				
36. Thailand is a country in Asia.				
37. The dog chased a cat in the garden.				
38. Shut the door.				
39. He is feeling better, isn't he?				
40. Who are you?				
41. What do you want to do?				
42. Do you want to go home?				
43. Was she at home?				
44. They have ten children?				
45. He is at the hospital?				
46. Lovely day, isn't it?				
47. Would you like cake or pie?				
48. I must buy coffee, not tea.				
49. Will you come if I drive you?				
50. He bought apples, peaches, pears, and oranges.				

Suggestion

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Signature ……..

(…….)

Index Objective Congruence (IOC) of the Questionnaire

Expert's name: …….

Instruction: Please rate the following elements of the questionnaire, according to the degree of index of item-objective congruence.

-1 = incongruent 0 = questionable or unclear 1 = congruent

Questionnaire	IOC Values			Comments
	-1	0	1	
1. Learning English pronunciation using the AR application can help me understand lessons better.				
2. I can improve my English pronunciation (stress and intonation) because of the AR application.				
3. The AR application can benefit learning process.				
4. I believe that the AR application can help me to increase academic achievement (e.g. grades).				
5. The AR application can enrich the learning contents.				
6. The information provided by the AR application is easy to understand and follow.				
7. The AR application is more interesting than traditional way of learning.				
8. I feel more comfortable to listen and repeat English words and sentences in front of smartphones or tablets.				
9. The sounds, pictures, and videos in the application make the tool more interesting.				
10. The AR application can increase my motivation in learning.				
11. The atmosphere of learning with the AR application is not serious, so it can reduce my stress and anxiety of learning.				
12. Learning with the AR application is easy and convenient.				
13. It is easy to read the information on the smart phone screen of the AR application.				
14. I want to learn with the AR application in other subjects.				
15. The AR application is an effective tool for teaching and learning English pronunciation.				

Suggestion

……
……

Signature ……..
(…….……)

Index Objective Congruence (IOC) of the Interview Questions

Expert's name: …….

Instruction: Please rate the following elements of the interview questions, according to the degree of index of item-objective congruence.

-1 = incongruent 0 = questionable or unclear 1 = congruent

Interview Questions	IOC Values			Comments
	-1	0	1	
1. How do you feel about using the AR application to assist your English pronunciation learning?				
2. Do you think your problematic English pronunciation has improved because of the AR application?				
3. Do you prefer traditional way of pronunciation learning or applying AR technology to learn language? Why?				
4. Have you found some limitations of using the AR application to assist your language learning?				
5. Do you have any suggestions for using AR application to assist your pronunciation learning?				

Suggestion

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……
……
……

Signature ……..

(…….……)

Appendix D

Evaluation results

The AR-incorporated pronunciation lessons
Lesson plan
Pronunciation tests
The questionnaire
Interview questions

Table A-1: The quality of the AR-incorporated pronunciation lessons

Item No.	Expert 1	Expert 2	Expert 3	$\bar{X}$	Remarks
Content					
1. Congruence of contents and objectives	-	-	5	5	Excellent
2. Subdivision of contents	-	-	5	5	Excellent
3. Sequencing of contents	-	-	5	5	Excellent
4. Continuity of contents	-	-	5	5	Excellent
5. Correctness of contents	-	-	5	5	Excellent
6. Appropriateness of contents	-	-	5	5	Excellent
7. Interestedness of contents	-	-	4	4	Good
Language Use					
1. Appropriate and correct language use	-	-	5	5	Excellent
2. Clarity of language	-	-	5	5	Excellent
Multimedia, Design, and Presentation					
1. Beautiful and interesting presentation	4	4	-	4	Good
2. Appropriateness of pictures, videos, and sounds	4	4	-	4	Good
3. Correctness and clarity of sounds	4	5	-	4.5	Excellent
4. Background song	5	5	-	5	Excellent
5. Text quality	4	4	-	4	Good
6. Text and background colors	3	4	-	3.5	Good
7. Place of button and sign	3	4	-	3.5	Good
8. Length of each lesson	5	4	-	4.5	Excellent
9. User-friendly organization of the lessons	4	4	-	4	Good
10. Overall design	4	4	-	4	Good
Total				**4.47**	**Good**

From Table A-1, all three experts including English language instructor and technology specialists were quite satisfied with the pronunciation lessons with the incorporation of AR technology as the overall mean of the evaluation was at “good” level ($\bar{X}$ = 4.47). However, the researcher developed the AR lessons in terms of content, multimedia, design, and presentation according to the experts’ suggestions as follows. The contents were revised in some parts. Texts presented in the application were adjusted not to be too long or too small. Moreover, buttons in the lessons were moved to be the in the same position of each pages.

Table A-2: The evaluation of the lesson plan using the index of item-objective congruence (IOC)

Items No.	Expert 1	Expert 2	Expert 3	$\bar{X}$	Results
Lesson Layout and Design					
1. The layout and design of the lesson is appropriate and clear.	1	1	1	1	Accepted
2. The layout and design of the lesson is organized effectively.	1	1	1	1	Accepted
Objectives					
3. The objectives are realistic, appropriate, and achievable for the lesson and time allocation.	1	1	1	1	Accepted
4. The objectives are relevant and consistent with the concept of the lesson.	1	1	1	1	Accepted
Stages and activities					
5. The activities are relevant to the stages in the framework of English pronunciation in terms of stress and intonation.	1	1	1	1	Accepted
6. The activities are relevant to the lesson objectives.	1	1	1	1	Accepted
7. Time is appropriately allocated to each stage.	1	1	1	1	Accepted
Procedures					
8. The procedure is in logical sequence.	1	1	1	1	Accepted
9. The procedure is clear and effective.	1	1	1	1	Accepted
Materials					
10. Materials are appropriate for the lesson.	1	1	1	1	Accepted
11. Materials are suitable for the students' ability	1	1	1	1	Accepted
12. Materials are interesting, motivating, and understandable	1	1	1	1	Accepted

According to Table A-2, all items in the lesson plan received IOC scores higher than 0.50 which indicated that they were accepted.

Table A-3: The evaluation of pronunciation pre-test and post-test using the index of item-objective congruence (IOC)

Item No.	Expert 1	Expert 2	Expert 3	$\bar{X}$	Remarks
Placement of word stress within a word					
1. empire	1	1	1	1	Accepted
2. dessert	1	1	1	1	Accepted
3. command	1	1	1	1	Accepted
4. postpone	1	1	1	1	Accepted
5. calendar	1	1	1	1	Accepted
6. elevator	1	1	1	1	Accepted
7. entertain	1	1	1	1	Accepted
8. agriculture	1	1	1	1	Accepted
9. nevertheless	1	1	1	1	Accepted
10. determine	1	1	1	1	Accepted
Stress and parts of speech					
11. I always buy produce at the market.	1	1	1	1	Accepted
12. His daughter was a drug addict.	1	1	1	1	Accepted
13. They conflict with each other again.	1	1	1	1	Accepted
14. They object to leaving early.	1	1	1	1	Accepted
15. A change resulting in a decrease.	1	1	1	1	Accepted
Compounding and stress placement					
16. bathroom, ballroom, big room	1	1	1	1	Accepted
17. notebook, new book	1	1	1	1	Accepted
18. bus station, gas station, large station	1	1	1	1	Accepted
19. We live in the white house.	1	1	1	1	Accepted
The president lives in the White House.	1	1	1	1	Accepted
Affixation and stress placement					
20. forecast	1	1	1	1	Accepted
21. journalese	1	1	1	1	Accepted
22. advantageous	1	1	1	1	Accepted
23. reasonable	1	1	1	1	Accepted
24. possible, possibility	1	1	1	1	Accepted
25. punish, punishment	1	1	1	1	Accepted
26. mystery, mysterious	1	1	1	1	Accepted
27. democrat, democracy, democratic	1	1	1	1	Accepted
28. photo, photograph, photographer, photography	1	1	1	1	Accepted
29. electric, electrical, electricity, electrician	1	1	1	1	Accepted
Additional rules for word stress					
30. CNN, USA, PhD, FBI, UCLA	1	1	1	1	Accepted

31. New York, South Africa, Canada	1	1	1	1	Accepted
32. sixteen, sixty, nineteen, ninety	1	1	1	1	Accepted
33. My number is 089-4853134.	1	1	1	1	Accepted
34. seventeen candles, first class ticket	1	1	1	1	Accepted
35. big black eyes, cute young girl	1	1	1	1	Accepted
Sentence stress and intonation	1	1	1	1	Accepted
36. Thailand is a country in Asia.	1	1	1	1	Accepted
37. The dog chased a cat in the garden.	1	1	1	1	Accepted
38. Shut the door.	1	1	1	1	Accepted
39. He is feeling better, isn't he?	1	1	1	1	Accepted
40. Who are you?	1	1	1	1	Accepted
41. What do you want to do?	1	1	1	1	Accepted
42. Do you want to go home?	1	1	1	1	Accepted
43. Was she at home?	1	1	1	1	Accepted
44. They have ten children?	1	1	1	1	Accepted
45. He is at the hospital?	1	1	1	1	Accepted
46. Lovely day, isn't it?	1	1	1	1	Accepted
47. Would you like cake or pie?	1	1	1	1	Accepted
48. I must buy coffee, not tea.	1	1	1	1	Accepted
49. Will you come if I drive you?	1	1	1	1	Accepted
50. He bought apples, peaches, pears, and oranges.	1	1	1	1	Accepted

According to Table A-3, all items in the pronunciation tests received IOC scores higher than 0.50 which indicated that they were accepted.

Table A-4: The evaluation of the questionnaire using the index of item-objective congruence (IOC)

Item No.	Expert 1	Expert 2	Expert 3	$\bar{X}$	Remarks
1. Learning English pronunciation using the AR application can help me understand lessons better.	0	1	1	0.67	Accepted
2. I can improve my English pronunciation (stress and intonation) because of the AR application.	1	1	1	1	Accepted
3. The AR application can benefit learning process.	1	1	0	0.67	Accepted
4. I believe that the AR application can help me to increase academic achievement (e.g. grades).	0	1	1	0.67	Accepted
5. The AR application can enrich the learning contents.	0	1	1	0.67	Accepted
6. The information provided by the AR application is easy to understand and follow.	1	1	1	1	Accepted
7. The AR application is more interesting than traditional way of learning.	0	1	1	0.67	Accepted
8. I feel more comfortable to listen and repeat English words and sentences in front of smartphones or tablets.	1	1	1	1	Accepted
9. The sounds, pictures, and videos in the application make the tool more interesting.	0	1	1	0.67	Accepted
10. The AR application can increase my motivation in learning.	1	1	1	1	Accepted
11. The atmosphere of learning with the AR application is not serious, so it can reduce my stress and anxiety of learning.	-1	1	1	0.33	Revised
12. Learning with the AR application is easy and convenient.	1	1	1	1	Accepted
13. It is easy to read the information on the smart phone screen of the AR application.	1	1	1	1	Accepted
14. I want to learn with the AR application in other subjects.	1	1	1	1	Accepted
15. The AR application is an effective tool for teaching and learning English pronunciation.	0	1	1	0.67	Accepted

According to Table A-4, almost all items received IOC scores higher than the qualified criteria except item 11 *"The atmosphere of learning with the AR application is not serious, so it can reduce my stress and anxiety of learning"*, so it was suggested to change to *"The AR application is suitable for my ability."* Although other items were accepted, some statements were revised according to the experts' suggestions as follows.

Item no. 2 was revised to "*The AR application enables me to learn English pronunciation systematically."*

Item no. 3 was revised to *"The AR application can support self-directed learning."*

Item no. 7 was revised to *"I prefer learning with the AR application to the traditional way of learning.*

Item no. 12 was revised to *"The AR application allows me to practice at my convenience."*

Table A-5: The evaluation of the interview questions using the index of item-objective congruence (IOC)

Item No.	Expert 1	Expert 2	Expert 3	$\bar{X}$	Remarks
1. How do you feel about using the AR application to assist your English pronunciation learning?	1	1	1	1	Accepted
2. Do you think your problematic English pronunciation has improved because of the AR application?	1	1	1	1	Accepted
3. Do you prefer traditional way of pronunciation learning or applying AR technology to learn language? Why?	1	1	1	1	Accepted
4. Have you found some limitations of using the AR application to assist your language learning?	1	1	1	1	Accepted
5. Do you have any suggestions for using AR application to assist your pronunciation learning?	1	1	1	1	Accepted

From Table A-5, all items of the interview questions received IOC scores higher than 0.50 which indicated that the interview questions were accepted. However, there was a suggestion to revised two items as follows.

Item no.3 was revised "*Do you prefer learning with the teacher in class or applying AR technology to learn language? Why?"*

Item no. 5 was revised to "*What are your suggestions for the improvement of the AR application to help you learn English pronunciation?"*

Appendix E

Pre-test and post-test scores
Students' pronunciation scores from the exercises in unit 1-8
Students' level of satisfaction derived from the questionnaire

Table A-6: Pronunciation pre-test and post-test scores

Students	Pre-test (50)	Post-test (50)
1	19	45
2	15	34
3	24	32
4	19	45
5	28	40
6	17	43
7	14	44
8	17	34
9	10	36
10	22	36
11	18	39
12	24	40
13	14	47
14	19	38
15	24	35
16	22	38
17	24	40
18	29	39
19	28	38
20	22	36
21	19	34
22	27	46
23	21	32
24	19	32
25	23	35
26	25	33
27	26	40
28	23	31
29	21	41
30	20	36
31	17	30
32	12	31
33	9	32
34	16	44
35	12	46
36	23	32
37	22	37
38	16	46
39	17	47
Total	**777**	**1484**
$\bar{X}$	**19.92**	**38.05**
S.D.	**5.002**	**5.196**

Table A-7: Students' pronunciation scores from the exercises in unit 1-8

Scores / Students	Unit 1 (10)	Unit 2 (10)	Unit 3 (10)	Unit 4 (10)	Unit 5 (10)	Unit 6 (10)	Unit 7 (10)	Unit 8 (10)
1	9	8	7	9	10	8	9	9
2	7	7	6	6	7	8	7	7
3	6	7	7	8	7	7	6	7
4	9	9	9	9	10	8	7	9
5	7	9	6	8	6	7	7	6
6	10	9	9	8	10	8	8	10
7	8	10	10	8	8	7	9	8
8	9	8	6	9	6	7	7	6
9	9	10	8	8	7	6	7	7
10	8	7	6	9	7	6	6	7
11	8	8	8	7	7	9	7	7
12	8	8	7	7	8	9	8	8
13	9	10	8	7	10	9	8	10
14	6	7	7	8	6	6	6	6
15	7	7	9	9	8	7	6	8
16	7	8	6	7	7	8	7	7
17	8	7	6	7	7	9	8	7
18	7	7	7	9	7	8	6	7
19	8	8	6	9	6	7	7	6
20	7	7	8	6	7	8	7	7
21	7	7	6	7	6	7	6	6
22	8	8	9	7	9	8	8	9
23	6	7	8	6	8	6	9	8
24	6	7	7	7	7	7	9	7
25	7	7	8	7	7	7	8	7
26	6	7	7	7	7	8	7	7
27	9	9	9	9	10	9	10	10
28	9	7	6	7	6	7	7	6
29	10	10	9	8	9	9	9	9
30	6	6	8	9	9	7	7	9
31	5	6	8	8	8	6	8	8
32	6	7	7	9	8	7	8	8
33	6	6	6	9	8	7	7	8
34	10	9	10	9	9	6	7	9
35	10	10	8	8	8	10	8	8
36	6	6	7	9	9	6	7	9
37	7	7	9	7	7	7	8	7
38	9	9	8	7	7	9	9	7
39	8	8	10	10	8	10	8	8
Total	**298**	**304**	**296**	**308**	**301**	**295**	**293**	**299**
$\bar{X}$	**7.64**	**7.79**	**7.59**	**7.9**	**7.72**	**7.56**	**7.51**	**7.67**

Table A-8: Students' level of satisfaction derived from the questionnaire

Students	S.1	S.2	S.3	S.4	S.5	S.6	S.7	S.8	S.9	S.10	S.11	S.12	S.13	S.14	S.15
1	4	4	4	4	4	4	3	4	3	3	4	4	2	3	3
2	4	5	5	4	4	4	4	4	4	4	4	4	3	3	3
3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
4	5	5	5	4	4	5	4	4	4	5	4	4	4	4	5
5	4	5	5	4	5	5	5	5	5	5	4	5	4	5	5
6	5	5	5	5	5	4	4	3	4	4	5	4	4	4	4
7	4	4	5	5	4	5	5	5	5	5	5	4	5	5	5
8	5	4	5	5	4	5	5	5	5	5	5	5	5	4	5
9	4	4	4	4	4	4	4	3	3	3	3	3	3	3	4
10	4	4	5	5	5	5	4	4	5	5	5	5	5	5	5
11	4	4	4	4	4	4	4	4	3	4	3	4	3	4	4
12	5	5	3	4	4	4	3	4	4	3	5	4	4	3	3
13	5	5	5	5	5	5	4	5	4	4	5	4	4	4	5
14	4	3	3	3	4	4	4	3	4	4	3	4	4	4	3
15	4	5	4	4	5	4	4	4	5	5	4	4	5	5	4
16	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
17	4	5	4	4	4	5	5	5	4	4	5	5	3	3	4
18	4	4	4	3	4	3	5	3	3	4	4	5	4	4	4
19	4	4	3	3	3	4	3	4	3	3	4	4	4	3	3
20	5	4	5	5	4	5	4	5	4	4	4	5	3	4	5
21	5	5	4	4	5	5	4	5	5	5	4	5	5	4	5
22	5	4	5	5	5	4	4	5	5	5	4	4	5	4	5
23	4	5	4	4	4	5	4	4	5	4	4	4	5	4	5
Students	**S.1**	**S.2**	**S.3**	**S.4**	**S.5**	**S.6**	**S.7**	**S.8**	**S.9**	**S.10**	**S.11**	**S.12**	**S.13**	**S.14**	**S.15**

24	5	5	5	4	5	5	4	5	5	5	5	4	4	5	5
25	4	3	4	4	3	3	3	3	2	3	4	5	3	3	4
26	4	3	4	3	4	3	4	3	4	3	5	5	4	3	3
27	4	4	3	5	4	4	3	5	5	4	4	5	4	5	5
28	4	4	4	3	4	3	5	4	5	3	3	5	5	4	5
29	4	3	5	3	4	4	3	4	5	4	5	5	4	4	4
30	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
31	5	4	5	5	5	5	4	4	4	4	4	4	4	4	4
32	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
33	4	4	4	3	3	4	4	4	4	3	4	4	5	4	4
34	5	4	5	5	5	5	5	4	4	5	4	5	5	4	5
35	4	3	3	5	4	3	5	4	3	5	4	3	5	4	4
36	5	5	5	5	5	5	5	4	4	5	4	5	5	5	5
37	5	4	5	4	5	5	5	5	4	4	4	5	5	5	5
38	5	5	5	4	4	5	5	4	5	5	5	5	5	4	5
39	5	4	4	5	4	4	4	3	4	4	4	4	4	5	4
Total	175	168	172	166	169	171	165	164	165	165	167	174	166	161	171
$\bar{X}$	**4.48**	**4.31**	**4.41**	**4.26**	**4.33**	**4.38**	**4.23**	**4.21**	**4.23**	**4.23**	**4.28**	**4.46**	**4.26**	**4.13**	**4.38**
SD	**0.51**	**0.6941**	**0.715**	**0.7511**	**0.62**	**0.711**	**0.706**	**0.732**	**0.81**	**0.777**	**0.6468**	**0.6003**	**0.818**	**0.6796**	**0.747**

Note 1: The statements in the questionnaire are as follows.

S.1 Learning English pronunciation using the AR application can help me understand lessons better.

S.2 The AR application enables me to learn English pronunciation systematically.

S.3 The AR application can benefit learning process.

S.4 I believe that the AR application can help me to increase academic achievement (e.g. grades).

S.5 The AR application can enrich the learning contents.
S.6 The information provided by the AR application is easy to understand and follow.
S.7 I prefer learning with the AR application to the traditional way of learning.
S.8 I feel more comfortable to listen and repeat English words and sentences in front of smartphones or tablets.
S.9 The sounds, pictures, and videos in the application make the tool more interesting.
S.10 The AR application can increase my motivation in learning.
S.11 The AR application is suitable for my ability.
S.12 The AR application allows me to practice at my convenience.
S.13 It is easy to read the information on the smart phone screen of the AR application.
S.14 I want to learn with the AR application in other subjects.
S.15 The AR application is an effective tool for teaching and learning English pronunciation.

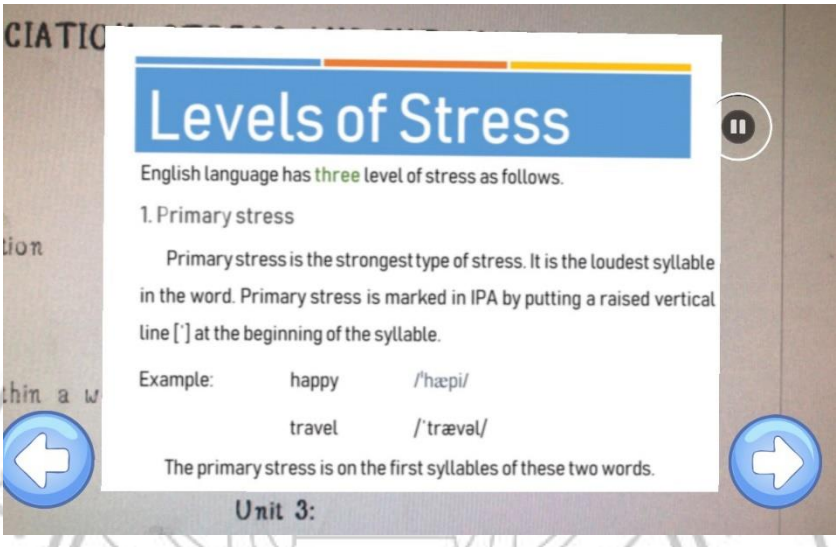
Note 2: The levels were interpreted as follows.

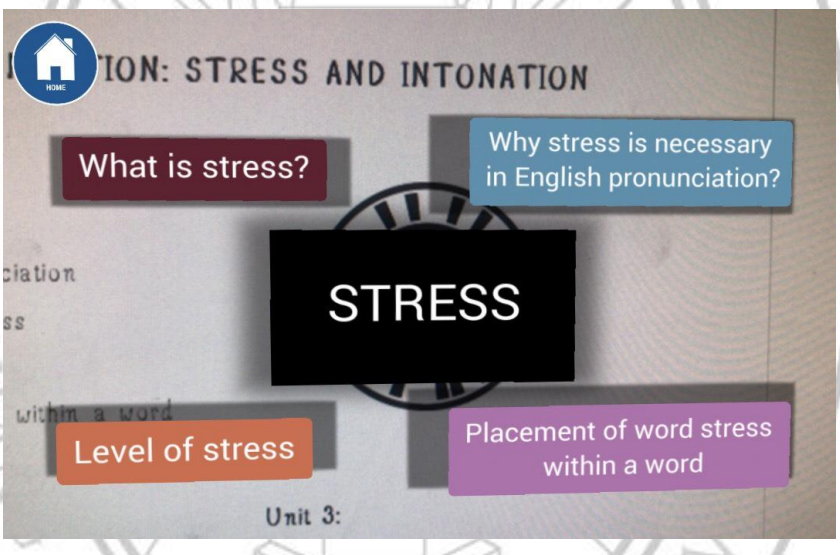
5 = strongly satisfied
4 = satisfied
3 = neutral
2 = dissatisfied
1 = strongly dissatisfied

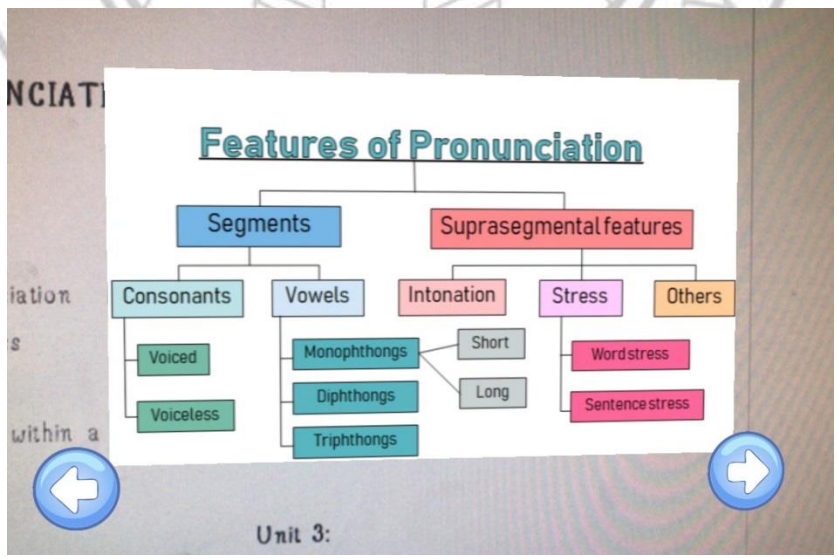
Appendix F

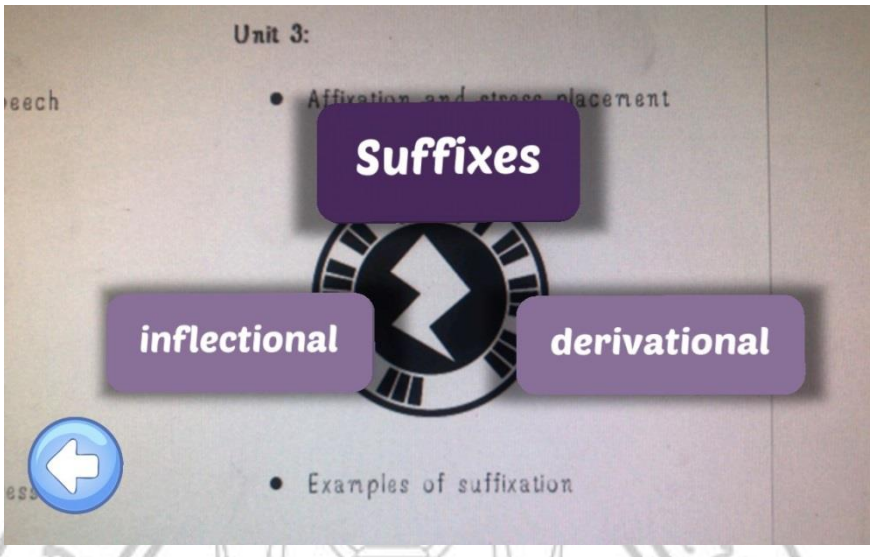
Examples of the AR-incorporated pronunciation lessons
Classroom environment

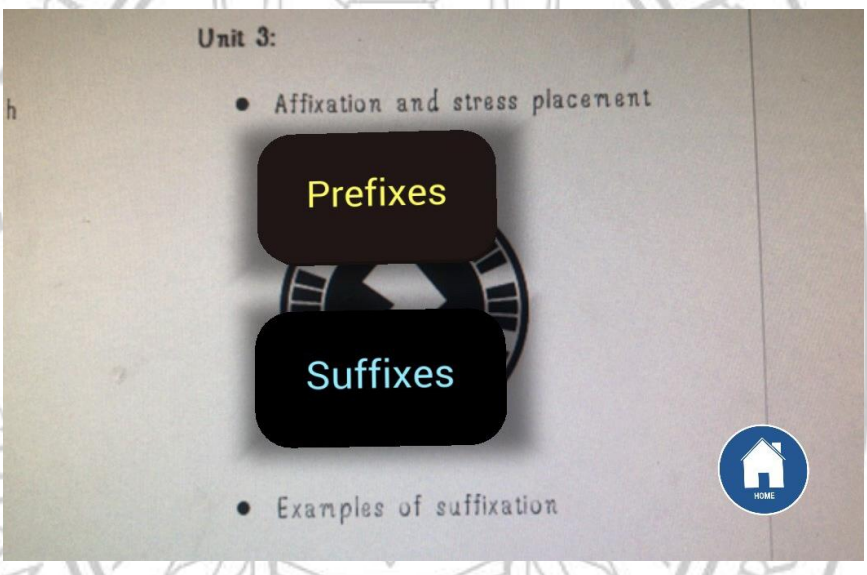
THE AR-INCORPORATED PRONUNCIATION LESSONS (EXAMPLES)



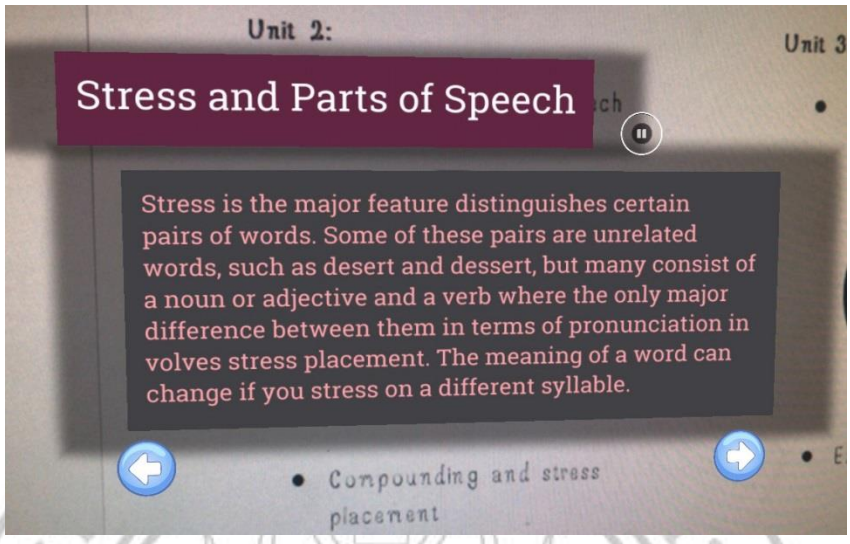


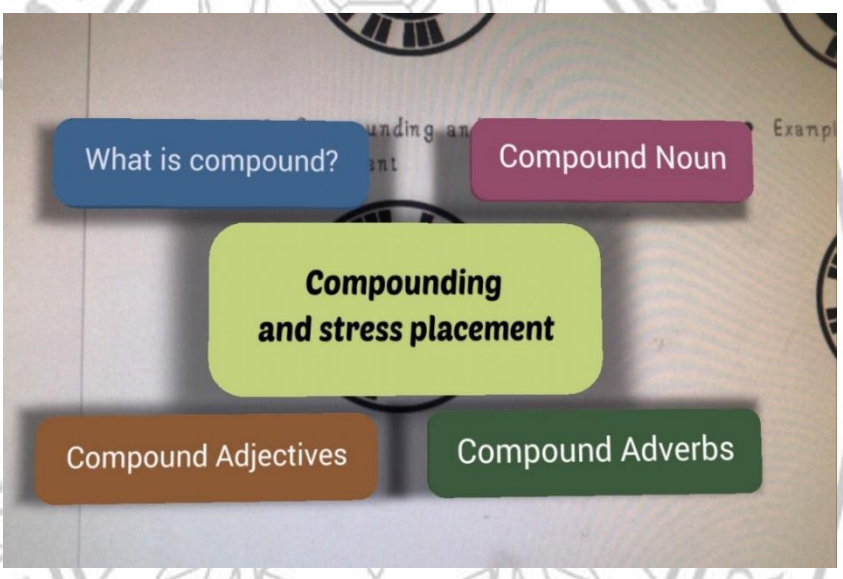


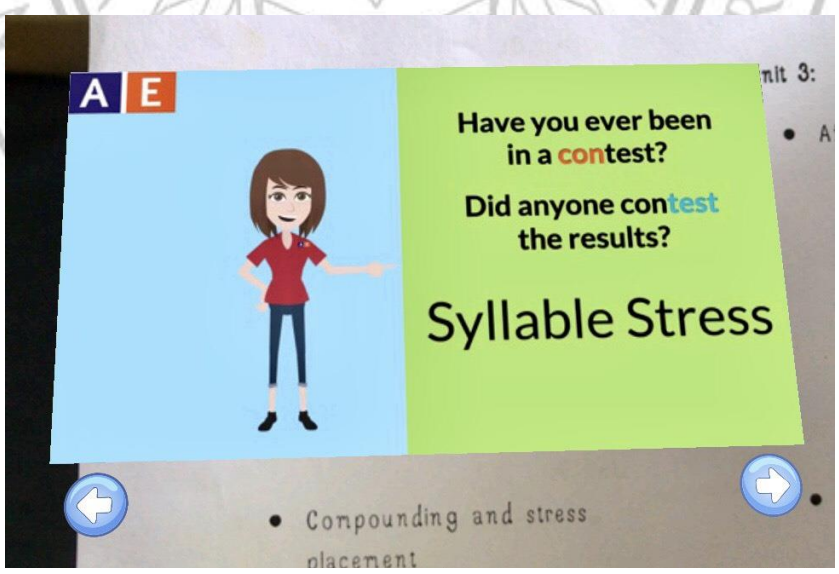

Unit 3:
Affixation and stress placement
Suffixes
inflectional
derivational
Examples of suffixation

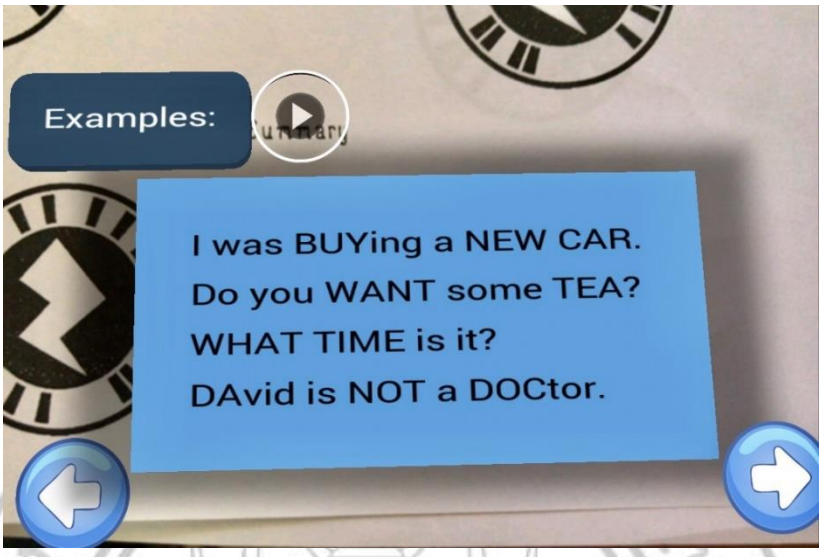

Unit 3:
Affixation and stress placement
Prefixes
Suffixes
HOME
Examples of suffixation


Three-syllable words
Unit 8: Summary
X x x
Animal
Elephant
FAculty
MIneral
RAdio
TRAgedy
CAlendar
EMphasis
FOreigner
ORchestra
REcipe
Uniform
CItizen
Evidence
FURniture
PUnishment
SIGnature

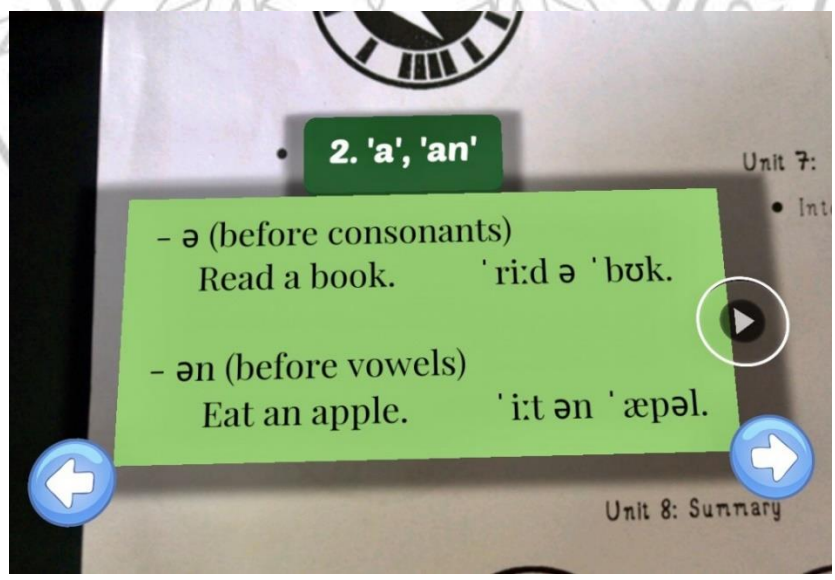

Unit 2:
Unit 3
Stress and Parts of Speech
Stress is the major feature distinguishes certain pairs of words. Some of these pairs are unrelated words, such as desert and dessert, but many consist of a noun or adjective and a verb where the only major difference between them in terms of pronunciation in volves stress placement. The meaning of a word can change if you stress on a different syllable.
Compounding and stress placement

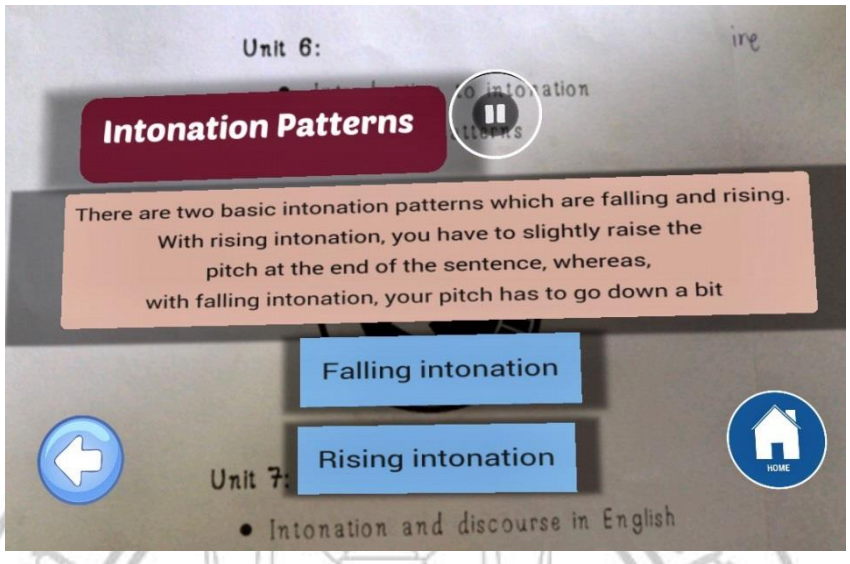

What is compound?
Compound Noun
Compounding and stress placement
Compound Adjectives
Compound Adverbs

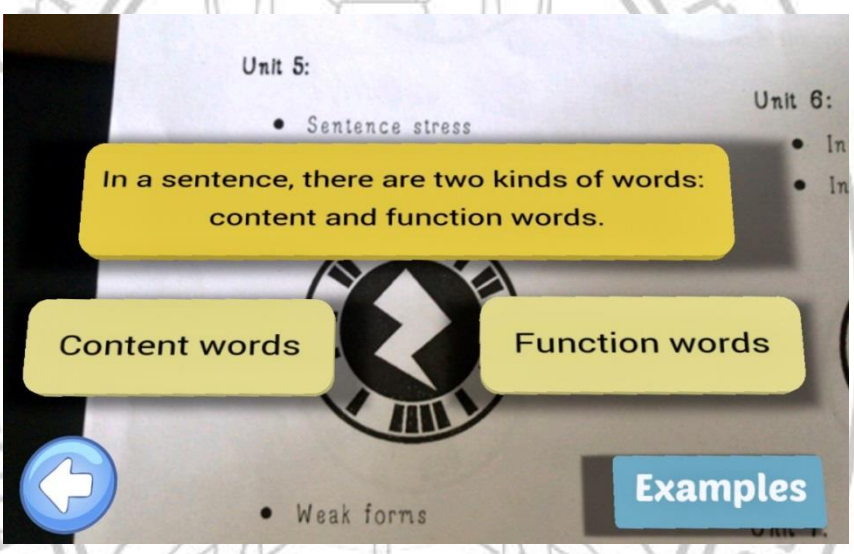

A E
Have you ever been in a contest?
Did anyone contest the results?
Syllable Stress
Compounding and stress placement

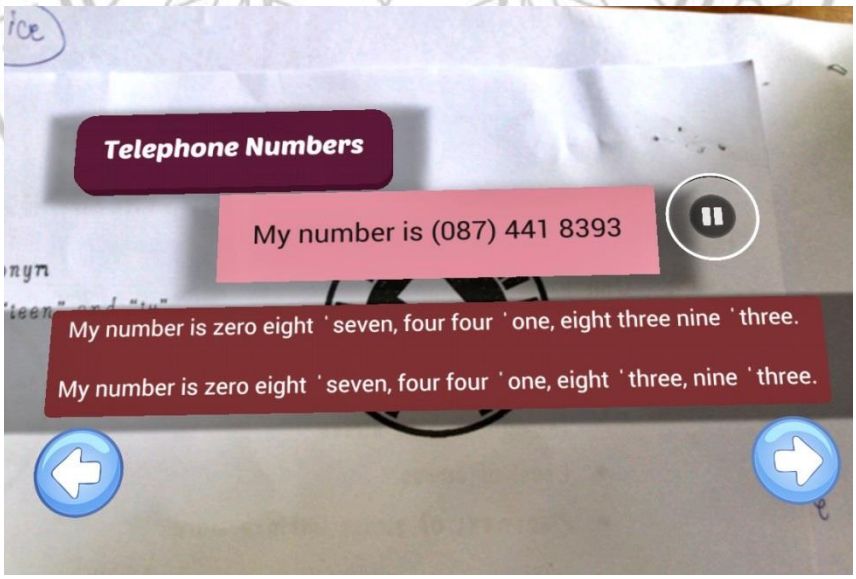

Examples:
I was BUYing a NEW CAR.
Do you WANT some TEA?
WHAT TIME is it?
DAvid is NOT a DOCtor.


OXFORD
online
ciation
ss
within a
Unit 3:

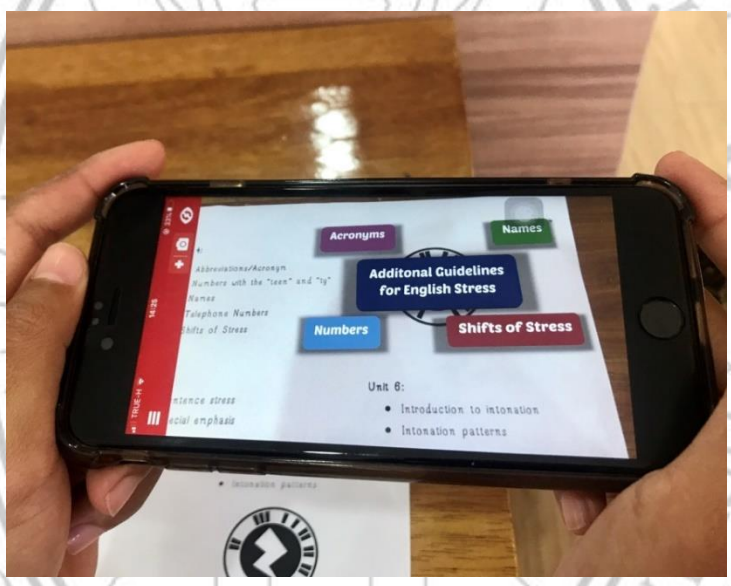

2. 'a', 'an'
Unit 7:
- ə (before consonants)
Read a book. ˈriːd ə ˈbʊk.
- ən (before vowels)
Eat an apple. ˈiːt ən ˈæpəl.
Unit 8: Summary

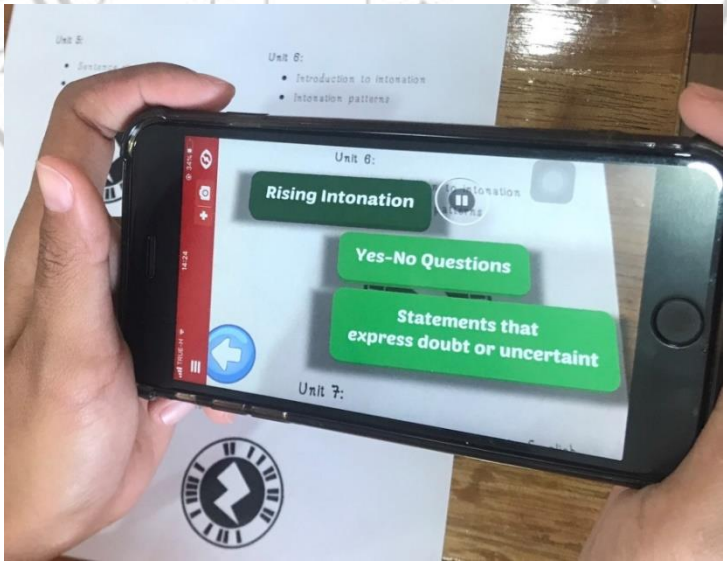

Unit 6:
Intonation Patterns
There are two basic intonation patterns which are falling and rising.
With rising intonation, you have to slightly raise the
pitch at the end of the sentence, whereas,
with falling intonation, your pitch has to go down a bit
Falling intonation
Rising intonation
HOME
Unit 7:
Intonation and discourse in English

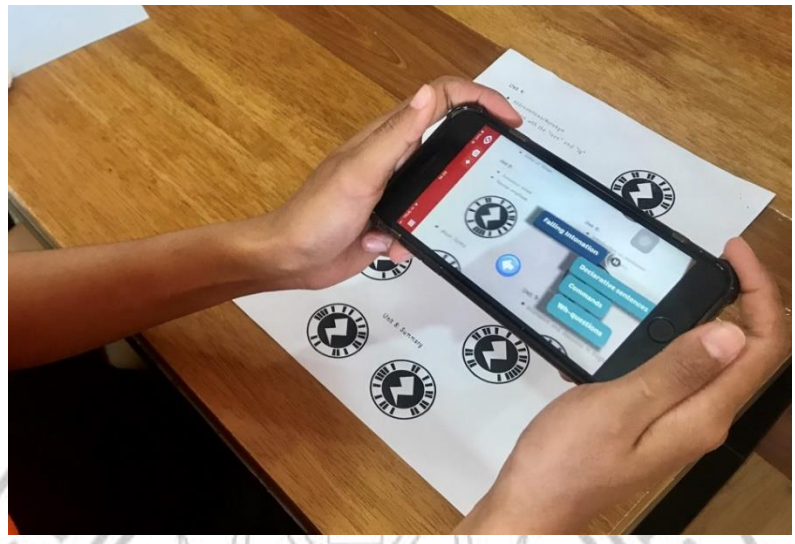

Unit 5:
Sentence stress
Unit 6:
In a sentence, there are two kinds of words:
content and function words.
Content words
Function words
Examples
Weak forms

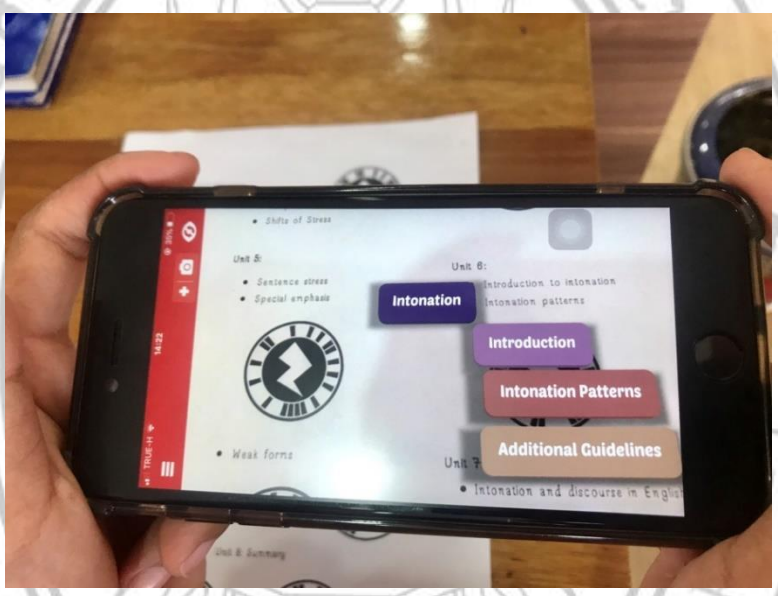

Telephone Numbers
My number is (087) 441 8393
My number is zero eight ˈseven, four four ˈone, eight three nine ˈthree.
My number is zero eight ˈseven, four four ˈone, eight ˈthree, nine ˈthree.

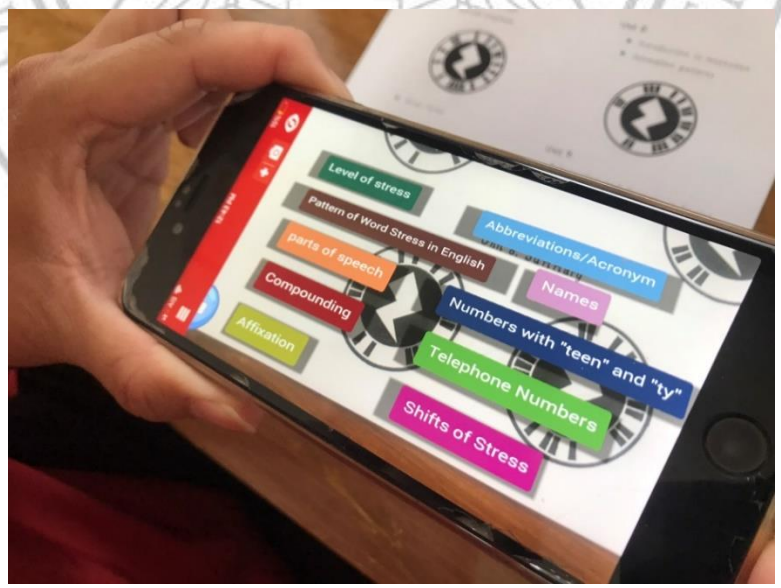
CLASSROOM ENVIRONMENT

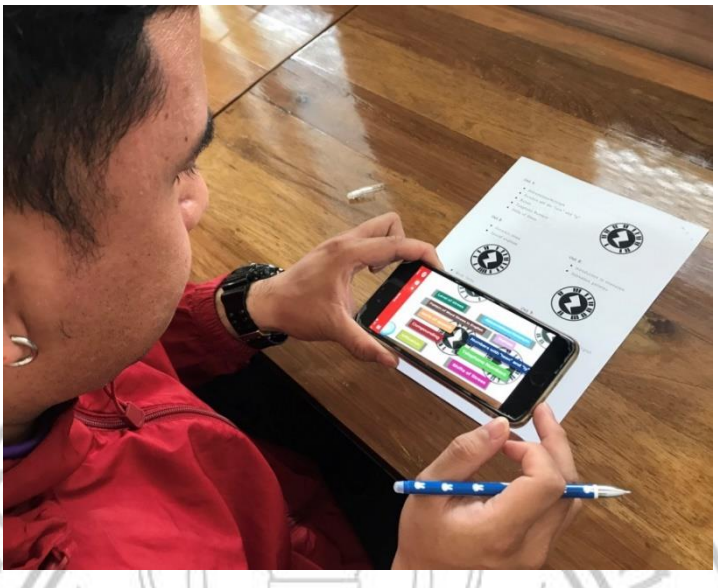




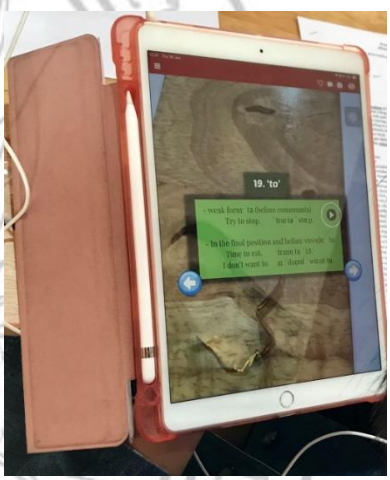


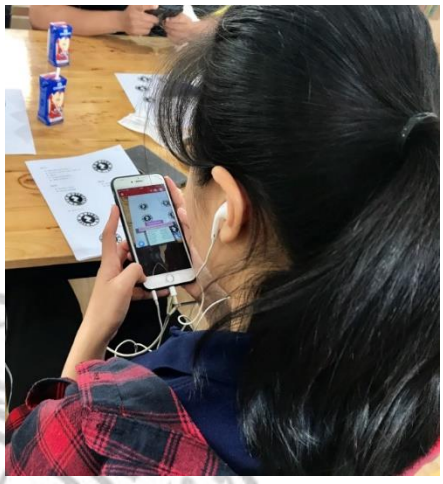

Intonation
Introduction
Intonation Patterns
Additional Guidelines


Level of stress
Pattern of Word Stress in English
parts of speech
Compounding
Affixation
Abbreviations/Acronym
Names
Numbers with "teen" and "ty"
Telephone Numbers
Shifts of Stress




Adjective + Noun
Unit 8 Summary
Nouns receive the primary stress.
deep POOL
large STORE
new PAPER
big WAR
long MAN
great FRIEND
orange SHIRT
small ROOM


19. 'to'



CURRICULUM VITAE

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Educational Background

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	Chiang Mai University

Work Experience

2017 – Present	Educator
	Chiang Mai Rajabhat University
	Chiang Mai, Thailand
2016-2017	English Tutor
	Top One School
	Chiang Mai, Thailand
2016	Cabin Crew
	Thai Smile Airways
	Bangkok, Thailand