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Article

Exploring optimal pronunciation teaching: Integrating instructional software into intermediate-level EFL classes in China

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Abstract

*This study investigates the effectiveness of teaching pronunciation with instructional software to a cohort of Chinese learners of English aged 13 to 16 at lower-intermediate level. It also explores the relationship between learners' attitudes towards pronunciation and their pronunciation learning. Participants were 60 students at a language school in China: 20 were instructed by a teacher, 20 used instructional software (*New Oriental Pronunciation*) alone, and the remaining 20 received combined instruction from teacher and software. Participants' pronunciation was evaluated in pretests and posttests. Presurveys and postsurveys assessed attitudes towards pronunciation. Additionally, a questionnaire collected students' reflections on the software, and observations were made during instruction. The greatest increase in performance was achieved by students receiving combined instruction, who also exhibited the greatest (positive) changes towards pronunciation. The authors suggest that this combination of human- and computer-assisted instruction particularly suits young learners. Recommendations are made for software design, teacher training, and research into computer-assisted pronunciation learning.*

KEYWORDS: ATTITUDES TOWARDS PRONUNCIATION; HUMAN-AIDED INSTRUCTION; INSTRUCTIONAL SOFTWARE; PRONUNCIATION; YOUNG LEARNERS

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Introduction

Despite the close relationship between pronunciation and successful oral communication (Celce-Muria, 1987; Eskenazi, 1999), pronunciation is neglected in both classroom practice and research (Ducate & Lomicka, 2001; Levis, 2007). In China, such inattention prevails in the teaching of English, despite that language's "higher than ever" status (Adamson, 2004, p. 195), which sees English courses mandated from Grade 3 of primary school. In contrast to listening, reading, and writing, speaking is neither routinely taught nor evaluated. The national syllabus requirements for pronunciation tend to be overlooked and teachers are not trained to implement them. The only official oral test, the College English Test-Spoken English Test, is non-compulsory and without consequences for graduation (National College English Testing Committee, n.d.). Converging factors thus militate against the teaching of pronunciation, despite the "strong contrast" (Molholt, 1988) between Chinese and English pronunciation. Indeed, the task's difficulty becomes another dissuasive factor: neither teachers nor students wish to invest in a time-consuming challenge without payoffs in terms of examination results.

Computer-based technologies may provide opportunities to overcome some of the discouraging difficulties, delivering high-quality samples of the target language, and expertly designed intensive instruction. Yet technology does not automatically confer improved pronunciation. Success depends on software design, implementation, and complex interactions between environmental factors such as curriculum, institutional context, and the characteristics of the learners themselves (Bax, 2011). Suter (1976), for example, proposes that better pronunciation can be achieved if students value pronunciation more highly. Similarly, using his Pronunciation Attitude Inventory (PIA), Elliott (1995) found that learners who were more concerned about pronunciation tended to attain better proficiency. While Lenneberg's Critical Period Hypothesis (1967) has been disputed for many areas of language acquisition, and notwithstanding potential adult success, numerous studies show that the earlier language learning occurs, the better pronunciation will be (Pinter, 2006; Piske, Mackay, & Flege, 2001; Singleton & Lengyel, 1995). However, the effectiveness of early interventions, particularly mediated by technology, could be limited by characteristics of young learners: vaguely formed language-learning goals (Pinter, 2006) and limited self-management skills (Ehrman, Leaver, & Oxford, 2003). Mindful of the impact of the situated interplay of such factors, this project studied a particular package, *New Oriental Pronunciation*, in a particular setting. Specifically, the study investigates the effectiveness of teaching pronunciation with instructional software in classes of early adolescent intermediate EFL learners in China. Furthermore, it investigates the interrelationship of learners' attitudes towards pronunciation and their performance.

Literature review

Pronunciation teaching

Goals

Before the 1960s, the achievement of native-like production dominated pronunciation teaching (Levis, 2007), with pronunciation primarily identified as "the accurate production of phonemes" (Pennington, 1989, p. 21). Two developments displaced this goal. First, while some post-adolescent learners do achieve native-like production, such individuals are exceptional (Birdsong, 2003; Bongaerts, 1999; Flege, Munro, & Mackay, 1995). Educators, therefore, came to the realization that native-like performance is an unrealistic benchmark (Jenkins, 1998). If, as Pennington (1989) states, the aim of language learners is communication with native speakers, the requisite standard is a level of pronunciation enabling such communication (Cenoz & Lecumberri, 1999; Levis, 2007). Therefore, intelligibility, allowing listeners to "adequately decode the words pronounced by a speaker" (Levis, 2007, p. 188), and comprehensibility, listeners' impressions of ease in understanding an utterance (Derwing & Munro, 2005), become the aim (Morley, 1991; Pennington & Richards, 1986).

Is, however, communicative ability a sufficient achievement for all learners? Even when communication is unimpeded, non-native pronunciation may attract discrimination because of a general perception of incompetence or particular negative beliefs regarding the nationality or culture "betrayed" by a specific accent. Students who have passed language examinations with oral components before studying abroad may still suffer negative stereotyping and psychological distress due to their accent (Schairer, 1992). Employment opportunities, for example, may be reduced if companies or organizations avoid recruiting foreign-accented speakers (Holmes, 1992). However, while ideally educational goals would be calibrated to students' future professional and personal needs, these cannot always be accurately predicted, as in the case of our junior high school students. Yet, early neglect of pronunciation will make it difficult to right wrongs and develop better accents when this would later be to their advantage.

Approaches to teaching

Research shows that both the segmental and suprasegmental aspects of pronunciation—respectively, the articulation of individual vowels and consonants; and prosody, stress, pitch, intonation, and rhythm—are critical for intelligibility and comprehensibility (e.g. Derwing, Munro, & Wiebe, 1997, 1998). But how should these two aspects be taught?

Most approaches emphasize the importance of native-like input, but even immersion requires supplementation by explicit study (Kissling, 2013; Lord, 2010). Research demonstrates that explicit instruction and intensive training can improve pronunciation (Elliott, 1995; González-Bueno, 1997; Lord, 2008, 2010; Verdugo, 2006). Kissling (2013) asserts that input, practice, and/or feedback are the most effective factors for pronunciation improvement. The traditional focus on segmental aspects has given way to a more recent emphasis on prosody (Jenkins, 2004). Popular teacher-directed methods for both segmental and suprasegmental aspects include imitation of models (provided by teachers or recordings), discrimination tasks, transcription practice, and minimal pair drills (Jones, 1997; Richards & Rodgers, 2014). However, potentially reducing the effectiveness of instruction is teachers' limited formal training in the area of pronunciation. Indeed, Breitkreutz, Derwing, and Rossiter (2002) found that 67% of ESL teachers surveyed in Canada lacked any training in pronunciation instruction, while Derwing and Munro (2005) report a similar situation in Britain and Australia. All these factors have encouraged the introduction of technology which can provide large amounts of target-language input and practice, and assist inadequately trained teachers.

Computer-Assisted Pronunciation Teaching

Applications of computer-based technologies to pronunciation teaching include use of authentic materials, multi-sensory learning modes, and, most commonly, instructional software providing instruction, practice, and tests. Computer-Assisted Pronunciation Teaching (CAPT) "has a range of advantages that give it special promise for language instruction" (Pennington, 1999, p. 429). In addition to models, it delivers opportunities for self-paced learning, individual practice for students reticent to speak in public and, in some cases, self-recording options. Furthermore, software can offer a stress-free environment (Roed, 2003) and the motivations of positive reinforcement and games (Beatty, 2013; Hubbard, 2009; Warren, Crabbe, & Elgort, 2009). The ideal software would also give "immediate and useful feedback" (Levis, 2007, p. 186, citing Neri, Cucchiarini, Strik, & Boves, 2002) which is not always possible in a busy classroom (Levis, 2007, overviews feedback options, their problems, and potential).

Empirical studies examining the effectiveness of CAPT provide evidence for the improvement of pronunciation in terms of sound segments

(Lambacher, 1999; Munro & Wang, 2004) and prosody (Levis, 2007; Stenson, Downing, Smith, & Smith, 1992; Tanner & Landon, 2001). One representative study, on which the current investigation is based, was conducted by Seferoğlu (2005) to ascertain whether the general quality of pronunciation could be improved by implementing instructional software in an EFL context at tertiary level. Participants were two classes of education majors. Over three weeks the control group studied pronunciation via traditional human-aided instruction. The experimental group used pronunciation software allowing students to practice sounds, words, phrases, and sentences through recording their own productions and comparing them to models. Pre- and posttests of pronunciation in which students made 10-minute presentations were recorded and assessed by four native English-speaking (NES) teachers. Comparison of test scores showed that the control group had no significant improvement, while the experimental group made considerable progress in communicative efficiency. While these studies, therefore, show that the multifaceted functions of CAPT can contribute to pronunciation instruction, technology interacts with a complex environment, impacting upon the realization of the potential of the technological artifact in a particular context.

Project aims

The current study investigates instructional software's contribution to pronunciation performance for young Chinese EFL students with a lower-intermediate proficiency level. It also explores the relationships between learners' attitudes, motivation, and achievement.

Four questions guide the investigation:

1. Is instructional software effective in improving pronunciation? If so, is it effective in improving a particular aspect?
2. Is instructional software more effective than human-aided instruction?
3. Can instructional software change learners' attitudes towards pronunciation?
4. Might a combination of software and human-aided instruction be optimal for young learners?

Methodology

Data collection took place in a language school in a prefecture-level city in northern China, with pronunciation instruction provided as a free two-week course during school holidays. Three sets of 20 participants each received a different mode of instruction. Students enrolled in the class of their choice, subject to the availability of places.

Participants

Participants were 60 Chinese-speaking students, 34 females and 26 males, high school students aged 13 to 16 (Table 1). All had learned English for at least five years, and none had lived outside China. Their average proficiency level was lower-intermediate: before graduation from junior high school at around 15, students are expected to master 800 words and 200 phrases, and to conduct simple conversations based on their textbook (Ministry of Education, 2001).

Group 1 (Control group): Human-aided instruction. A teacher provided instruction and students practiced pronunciation through activities, games, and communication with her and their peers. The atmosphere was convivial and interactive. The teacher was a non-native English-speaker (NNES) of nine years' teaching experience who would have received some pronunciation training as an undergraduate. Each lesson contained 20 minutes of instruction and 25 minutes of practice, the content of which corresponded to that of the software.

Group 2 (First experimental group): Computer-aided instruction. Initially, the lead researcher briefly introduced the software, presenting its more engaging features, such as voice recording for comparison with models. Students then used the software by themselves, following a guide prescribing the work to complete in each class. Once these exercises were finished, students made their own choice of activities, without additional guidance, apart from some technical assistance.

Group 3 (Second experimental group): Combined instruction. As with Group 2, the lead researcher first presented the software. Then, each day, participants were first instructed by the teacher for around 20 minutes, before using the instructional software individually for 25 minutes. The teacher was the same as for Group 1, thus eliminating the variable of teacher's approach. The inclusion of this second experimental group, which distinguishes this study from Seferoğlu's (2005) investigation, responded to our hypothesis that teachers were important for young learners.

Table 1: Participant Information

	Group 1 Human-aided instruction		Group 2 Computer-aided instruction		Group 3 Combined instruction	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
13 years	2	6	3	0	3	4
14 years	1	6	5	3	3	3
15 years	1	3	4	5	2	1
16 years	1	0	0	0	1	3
Total	5	15	12	8	9	11

Software

The lead researcher applied her previously developed criteria[1] to the three most popular English pronunciation software packages in China (Sales ranking, 2011). New Oriental Pronunciation, developed by an authoritative language-training agency, scored highest and was also the best-selling product (Sales ranking, 2011). This CDROM software could easily be installed in the school's language laboratory. According to its developers, while beginners are unlikely to understand the example sentences, the software suits any higher level of proficiency. Instructions in Mandarin on the CD explain key concepts and phonological terms. Students can:

- Work on segmental aspects:
    - Listen to samples of each vowel and consonant
    - Learn methods of articulation (Figure 1)
    - Practice sounds with exercises
- Work on suprasegmental aspects:
    - Record their productions of words, phrases, and sentences; compare visualizations of them with samples
    - Practice words and phrases with exercises, such as listening discrimination (Figure 2)
    - Practice sentence intonation, stress, and rhythm (Figure 3)

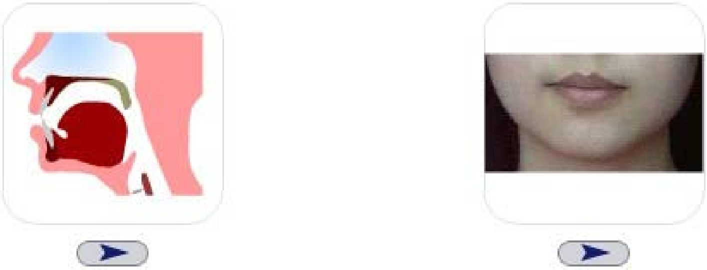

Figure 1: Graphics showing articulation.

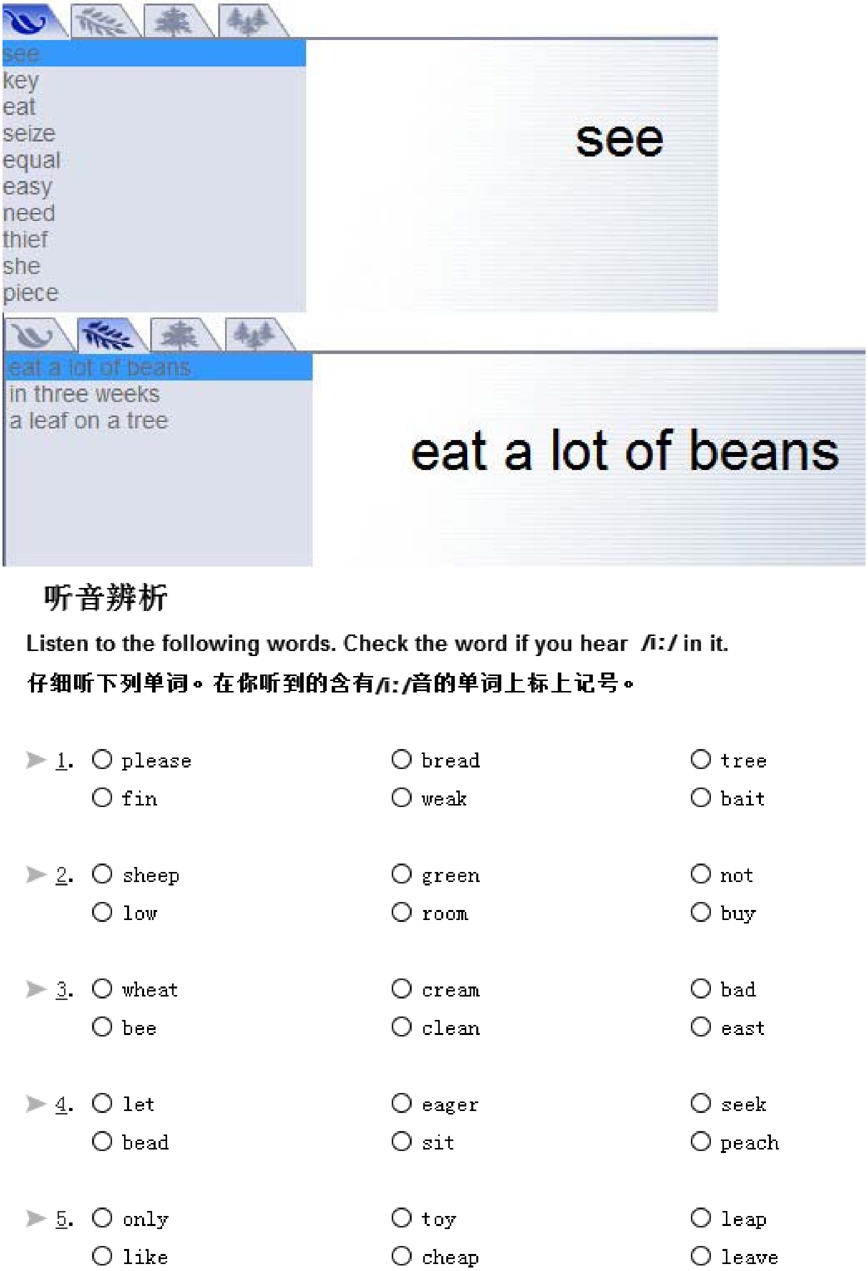

Figure 2: Examples of sample words, phrases, and discrimination exercises.

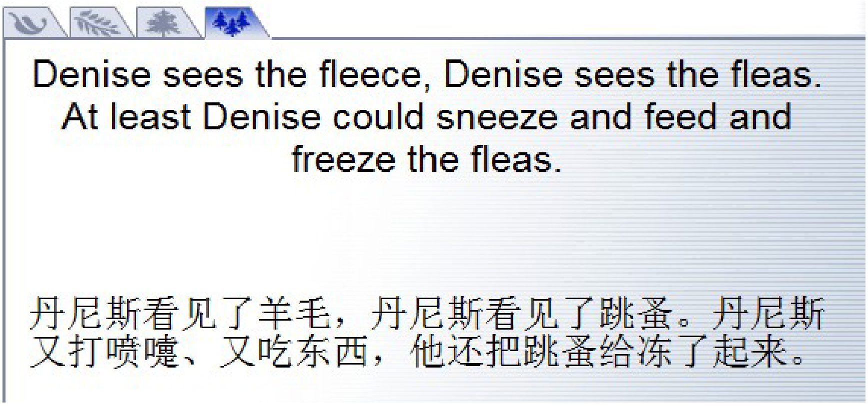

Figure 3: Exercise on sentence rhythm and a specific sound.

Testing instruments

Pretests and posttests. Students read aloud selected passages (short understandable stories of comparable difficulty) and gave a one-minute presentation on a familiar topic (e.g. my bedroom/bike/cat). In order to increase data reliability, each student's performance was assessed by both a NES and a NNES teacher (Fayer & Krasinski, 1987; Zhang & Elder, 2011). Neither had previously met the participants. Students' performance in the posttest was assessed without reference to pretest results. Raters used an adapted version of Seferoğlu's (2005) Likert-type scale with six items relating to "the communicative efficiency" of segmental and suprasegmental aspects of pronunciation (Appendix 1). Before analyzing the data, the overall intra-class correlation coefficients of the two raters' scores for pretest and posttest were calculated, demonstrating inter-rater reliability of 0.880 in the pretest and 0.932 in the posttest. The mean of the two raters' scores was used in analysis.

*Presurveys and postsurveys***.** These surveys adapted Elliott's PIA (1995), translated into Chinese, and modified to refer to English rather than the Spanish of the original (Appendix 2). For each of 12 statements, learners used a Likert-type scale to choose the best description from 1 (*never or almost never true of me*) to 5 (*always or almost always true of me*). Two negative items in the original were rephrased positively, to avoid confusion for our young participants: e.g. "I will never be able to speak Spanish with a good accent" became "I will be able to speak English with a good accent."

*Classroom observation***.** The lead researcher took notes in the classroom and laboratory on students' behavior and attitudes. Each group was observed six times (30 minutes per session).

Questionnaire on software. Groups 2 and 3 responded to open-ended questions eliciting reflections on the software (Appendix 3).

Procedure

All participants completed a pronunciation pretest and a presurvey on their attitudes towards pronunciation learning. The lead researcher then gave a concise presentation on the importance of pronunciation, to facilitate understanding of the project. Over the following two weeks, the groups were instructed according to the respective methods. Content for all groups was the same and was based on the instructional software. In order to control for time, the two experimental groups only used the software in the school's language laboratories, during scheduled classes. Exposure to instruction was, therefore, identical: 45 minutes per day and 7.5 hours in total.

When the program ended, participants underwent an immediate post-test with the same form as the pretest, and a postsurvey on their attitudes towards pronunciation learning. Groups 2 and 3 also completed the questionnaire. Table 2 summarizes the data collection.

Table 2: Data Collection Process

Instrument	Target	Timing with respect to the course	Data type
Test	Pronunciation performance	Before and after	Quantitative
Survey	Attitudes towards pronunciation	Before and after	Quantitative and qualitative
Observation	Behavior	During	Qualitative
Questionnaire	Opinions on the software	After	Qualitative

This article focuses on the quantitative data, complementing them with the qualitative findings.

Results

The presentation and analysis of the data in this section are organized according to the four research questions.

Effectiveness of instructional software in improving pronunciation: Results for Group 2

Was instructional software effective in improving pronunciation? If so, did a particular aspect improve? What did students believe were the beneficial features of the software? The data for participants using instructional software alone, Group 2, are critical here.

Table 3: Paired-samples *T*-test Results for the Pretest and Posttest Scores for Group 2

Pair	*M*	*SD*	*SE*	*t*	*df*	Sig. (2-tailed)
Pretest	18.83	1.16	0.26	−8.33	19	0.000
Posttest	20.60	1.78	0.40			

$p < 0.01$

As Table 3 shows, a paired-samples *t* test on pretest and posttest scores reveals higher scores in the posttest ($M = 20.60$, $SD = 1.78$) than in the pretest ($M = 18.83$, $SD = 1.16$). With alpha set at 0.01, the paired samples *t* test was significantly different, $t\,(19) = -8.33$, $p = 0.000$, $r = 0.89$. After two weeks' instruction using only the software, students had made significant improvement, evidencing the benefits of instructional software for general pronunciation quality.

Table 4: Descriptive Statistics for Score Differences between Posttest and Pretest on Different Pronunciation Aspects for Group 2

Aspect	*n*	*M*	*SD*	Range	Minimum	Maximum
Vowels, consonants	20	0.475	0.41	1.0	0.0	1.0
Diphthongs, consonant clusters	20	0.475	0.47	1.0	0.0	1.0
Linkage of sound	20	0.200	0.41	1.5	−0.5	1.0
Word stress	20	0.225	0.41	1.5	−0.5	1.0
Sentence stress, rhythm	20	0.275	0.41	1.5	−0.5	1.0
Intonation, pitch	20	0.150	0.29	1.0	0.0	1.0

Table 5: Paired-samples *T*-test Results for the Segmental and Suprasegmental Scores for Group 2

Pair	*M*	*SD*	*SE*	*t*	*df*	Sig. (2-tailed)
Segmental aspect	0.475	0.29	0.07	3.18	19	0.005
Suprasegmental aspect	0.213	0.20	0.04			

$p < 0.01$

For all students in Group 2, the instructional software was clearly helpful to some degree. Table 4 shows that students obtained the largest improvement on two of the segmental aspects of pronunciation, individual sounds and sound clusters, with the same mean increased scores of 0.475. The improvement on suprasegmental aspects was less, with the smallest mean of increased scores occurring for the item of intonation and pitch. A paired-samples *t* test on segmental and suprasegmental scores (Table 5) revealed participants made significantly greater progress on segmental ($M = 0.475$, $SE = 0.29$) than on suprasegmental aspects of pronunciation ($M = 0.213$, $SE = 0.20$) with a large effect, $t\ (19) = 3.18$, $p < 0.01$, $r = 0.59$. It can be concluded that the instructional software was more effective on individual vowels and consonants and sound clusters.

The questionnaire data show that this increase in scores was accompanied by a belief in the effectiveness of the software as a learning tool. Six of the twenty participants in Group 2 stated that the software was useful for their learning, while a further eight regarded it as partially effective. As to why it was useful and effective, many advantages of the software were evoked, most frequently the quantity and variety of forms of practice it allowed. Additionally, students mentioned that those who finished the prescribed workload then proceeded to self-directed use of the materials. The comparison of students' recordings with models was considered useful because it enabled the identification and repair of mistakes through repeated listening and practice. Participants also stated that the software helped them to speak more fluently and clearly. Furthermore, comments such as "I can speak freely with it" aligned with the advantage mentioned earlier, that CAPT allows students who are unwilling to speak in public to practice individually. In terms of design, 16 students thought the software was easy to use. Finally, some participants praised the package as enjoyable: e.g. "The content of this software is interesting. It is funny to attempt to read the sentences with sounds that are really difficult to produce."[2]

The questionnaire also reveals three categories of perceived limitations of the software: lesson quality, factors relating to ease of use, and further demotivating factors. First, students complained that they received neither direct feedback on their performance nor even a score. The link between some lesson content and real life was seen as tenuous: lessons were "too abstract" and some sentences, especially those used to practice particular sounds, were far removed from likely communicative use (e.g. Figure 3). Second, students encountered comprehension difficulties. Technical terms were obscure, and the necessary frequent recourse to English–Mandarin dictionaries was off-putting. Third, several comments indicated aspects of the software which limited its effectiveness simply by discouraging enthusiastic use. Some learners found the dark blue and gray colour-scheme unappealing; others regretted the lack of games. Finally, although many students enjoyed the self-recording function, one said, "It is strange listening to my own voice," indicating perhaps that some participants were reluctant to use it.

These off-putting factors may have contributed to the behavior noted in the classroom observations, although the participants' age was arguably also critical: staying on-task was difficult for Group 2. While some students had the curiosity necessary to explore the software and enjoy independent learning, many could not learn purposefully despite the study guides provided. Their ability to manage their behavior and resist the distractions of computer games or chatting was limited.

Comparison of human-aided instruction and instructional software: Results for Groups 1 and 2

Instructional software has been shown to have positive outcomes for our learners, but does it outperform human-aided instruction as suggested by the literature review? In this section, Group 1 (human instruction alone) and Group 2 (software alone) are compared. An independent-samples *t* test was conducted to compare effectiveness of the modes of instruction (Table 6). Contrary to expectations, the mean of score differences for Group 1 was 2.35 ($SD = 0.88$), whereas for Group 2 it was 1.78 ($SD = 0.95$). This difference was significant at a level of 0.05 ($t\ (38) = 1.99$, $p = 0.027$) with a medium-sized effect $r = 0.31$. Group 1, recipients of human-aided instruction alone, saw a greater improvement than Group 2.

Table 6: Independent-samples *T*-test Results for the Differences of Scores in Pretest and Posttest for Groups 1 and 2

Group	*M*	*SD*	*SE*	*t*	*df*	Sig.
Group 1	2.35	0.88	0.20	1.99	38	0.027
Group 2	1.78	0.95	0.21			

$p < 0.05$

Was human-aided instruction effective for every aspect of pronunciation or was it, like the software, more effective for particular aspects? Table 7 provides descriptive statistics of pronunciation scores for participants instructed by the teacher alone. Similarly to the performance of the instructional software group, the score means for individual sounds and sound clusters are higher than those for suprasegmental items. However, effectiveness of human-aided instruction on the suprasegmental aspect was not as low, especially for the items of word stress ($M = 0.425$, $SD = 0.41$) and sentence stress and rhythm ($M = 0.475$, $SD = 0.44$). A paired-samples *t* test (Table 8) shows that Group 1 achieved greater progress in segmental ($M = 0.575$, $SD = 0.26$) than in suprasegmental aspects of pronunciation ($M = 0.300$, $SD = 0.20$). This difference was significant $t\ (19) = 3.42$, $p < 0.01$, and represents a large-sized effect, $r = 0.62$.

Table 7: Descriptive Statistics for Score Differences between Posttest and Pretest on Different Pronunciation Aspects for Group 1

Aspect	*N*	*M*	*SD*	Range	Minimum	Maximum
Vowels, consonants	20	0.625	0.46	1.0	0.0	1.0
Diphthongs, consonant clusters	20	0.525	0.47	1.0	0.0	1.0
Linkage of sound	20	0.125	0.32	1.0	0.0	1.0
Word stress	20	0.425	0.41	1.0	0.0	1.0
Sentence stress, rhythm	20	0.475	0.44	1.0	0.0	1.0
Intonation, pitch	20	0.175	0.34	1.5	−0.5	1.0

Table 8: Paired-samples *T*-test Results for the Segmental and Suprasegmental Scores for Group 1

Pair	*M*	*SD*	*SE*	*t*	*df*	Sig. (2-tailed)
Segmental aspect	0.575	0.26	0.06	3.42	19	0.003
Suprasegmental aspect	0.300	0.20	0.05			

$p < 0.01$

The questionnaire asked students to compare instructional software and a human teacher. Opinions from Group 2, software alone, confirmed the importance of a human teacher. The most significant differences related to individualized feedback. Students mentioned that, unlike the software, a "real" teacher could tell them specifically where and why their pronunciation was incorrect, and how to repair it. Some commented that the speed of recordings provided by the software could not be varied whereas a teacher could slow down to enhance understanding. On the other hand, while a teacher could become annoyed at requests for multiple repetitions, the software was always "nice." Yet the instructional software's capacity for infinite, patient, modeling could not compensate for its lack of intelligent communication.

Again it can be argued that effectiveness related not only to the characteristics of software and teacher, but also to the observed behavior of the students. Group 1 enthusiastically participated in teacher-directed activities. Different tasks were designed to maintain learners' attention and the use of games and prizes, a common classroom strategy, motivated them to practice. Although sometimes students still lost focus, time off-task was considerably less than for Group 2.

Instructional software and learners' attitudes towards pronunciation

The third research question asks if instructional software can modify attitudes towards pronunciation, remembering that positive attitudinal changes have been associated with improvement in performance. Table 9 presents the attitudinal survey score means, standard deviations, and ranges for all groups, and indicates that each showed positive attitudinal change towards pronunciation and pronunciation learning. For the software-alone group, this change could only be attributable to the software. A paired-samples *t* test displayed a significant difference at a significance level of 0.01 between scores of pre-survey and scores of postsurvey (t (19) = −9.46, p = 0.000) (Table 10) for Group 2, implying that the software was very helpful for improving users' attitudes.

Table 9: Descriptive Statistics for Presurvey and Postsurvey of Participants in Groups 1, 2, and 3[3]

Group	Survey	*M*	*SD*	Range	Minimum	Maximum
Group 1 (n = 20)	Presurvey	39.45	2.09	8	36	44
	Postsurvey	43.35	2.80	10	38	48
Group 2 (n = 20)	Presurvey	40.00	3.29	11	35	46
	Postsurvey	43.75	3.68	15	38	53
Group 3 (n = 20)	Presurvey	39.25	2.94	10	35	45
	Postsurvey	44.15	3.17	10	38	48
Total (N = 60)	Presurvey	39.57	2.79	11	35	46
	Postsurvey	43.75	3.20	15	38	53

Table 10: Paired-samples *t*-test Results of the Presurvey and Postsurvey Scores for Group 2

Pair	*M*	*SD*	*SE*	*t*	*df*	Sig. (2-tailed)
Presurvey	40.00	3.29	0.73	−9.46	19	0.000
Postsurvey	43.75	3.68	0.82			

$p < 0.01$

The Pearson correlation coefficient was used to calculate the strength of association between increases of scores in tests on general quality of pronunciation and of scores in surveys on attitudes towards pronunciation (Table 11). The positive correlation of nearly 0.8 was significant at $p < 0.01$ (one-tailed).

Table 11: Correlation Coefficient between Increases of Scores in Tests and Increases of Scores in Surveys for All Participants

Variable	Pearson Correlation	Sig.	*N*
Increases of scores in tests and Increases of scores in surveys	0.778**	0.000	60

** Pearson Correlation Coefficient is significant at $p < 0.01$, one-tailed

Clearly learners' attitudes towards pronunciation played an important role for all groups: as predicted, the more positive their shift in attitude, the greater their improvement on performance. Again, for Group 2, all changes can only be attributed to the software. Nonetheless, a striking result is that the largest positive change for Group 2 relates to item 5: *I believe more emphasis should be given to proper pronunciation in class*. "Class" here could only mean a traditionally taught, teacher-led scenario—that is, 15 out of 20 students who used the instructional software alone emphasized the value of the teacher.

Finally, a repeated-measures one-way ANOVA explored differences in terms of attitudinal change (Table 12; Figure 4). According to Levene's test (Table 13), the group variances are equal, $p > 0.05$. Participants' attitudes towards pronunciation have changed significantly, $p < 0.05$. However, although Group 3 experienced the largest degree of mean changes, there was a non-significant effect of instruction types on changes of students' attitudes towards pronunciation, $F(2, 57) = 2.570$, $p > 0.05$.

Table 12: Results of Repeated-measures One-way ANOVA on Attitudinal Surveys

Source	*SS*	*MS*	*df*	*F*	Sig.
Attitude survey	525.01	525.01	1	345.261	0.000
Attitude survey * Group number	7.82	3.91	2	2.570	0.085
Error	86.68	1.52	57		

Table 13: Results of Levene's Test on Attitudinal Surveys

Source	*F*	df_1	df_2	Sig.
Presurvey	1.87	2	57	0.163
Postsurvey	0.37	2	57	0.692

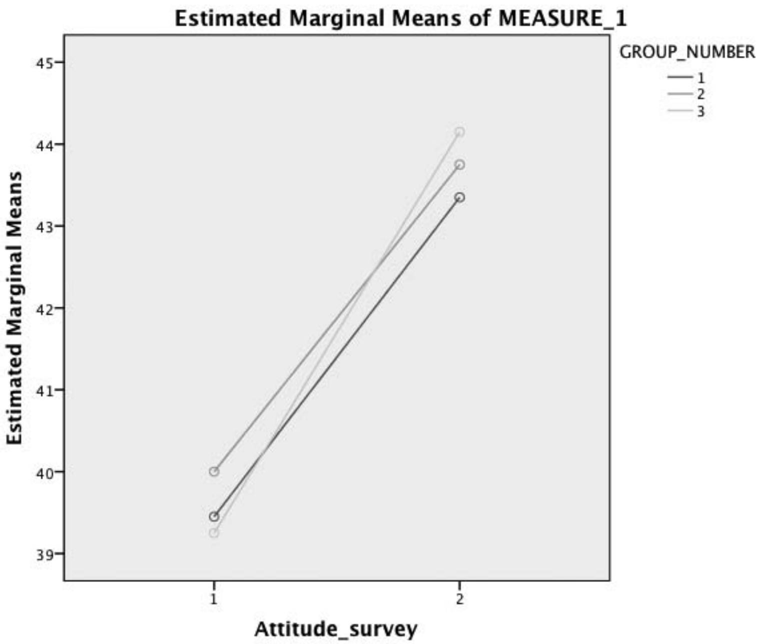

Figure 4: Changes in attitude surveys for Groups 1, 2, and 3.

Optimal teaching approach

It has been demonstrated that instruction by software alone was less effective than human-aided instruction, and that, through their survey answers and in-class behavior, students showed that neither instructional software nor a human teacher was perfect. This section explores whether a combination of them, as experienced by Group 3, was the most effective for pronunciation learning.

Table 14: Descriptive Statistics for Pretest and Posttest Performance (Test Scores)

Group	Tests	*M*	*SD*	Range	Minimum	Maximum
Group 1 (*n* = 20)	Pretest	19.63	1.38	5.0	17.0	22.0
	Posttest	21.98	1.92	6.5	18.5	25.0
Group 2 (*n* = 20)	Pretest	18.83	1.16	4.0	17.0	21.0
	Posttest	20.60	1.78	6.5	17.5	24.0
Group 3 (*n* = 20)	Pretest	19.00	1.39	5.5	16.5	22.0
	Posttest	21.38	1.74	6.0	19.0	25.0
Total (*N* = 60)	Pretest	19.15	2.79	5.5	16.5	22.0
	Posttest	21.32	3.20	7.5	17.5	25.0

Table 15: Descriptive Statistics for Score Changes of Pronunciation Tests

Group	*M*	*SD*	Range	Minimum	Maximum
Group 1 ($n = 20$)	2.35	0.88	3.0	1.0	4.0
Group 2 ($n = 20$)	1.78	0.95	3.0	0.5	3.5
Group 3 ($n = 20$)	2.38	0.83	3.0	1.0	4.0

Table 16: Results of One-way ANOVA on Pronunciation Performance

Source	*SS*	*df*	*MS*	*F*	Sig
Between Groups	4.61	2	2.30	2.937	0.061
Within Groups	44.73	57	0.79		
Total	49.33	59			

$p > 0.05$

Table 17: Levene's Test of Score Changes

Source	df_1	df_2	Sig.
Increased scores	2	57	0.572

$p > 0.05$

Table 18: Contrast Tests of Different Groups' Pronunciation Performance

Contrast	*SE*	*df*	*t*	Sig. (2-tailed)
Groups 3 & 2	0.28	57	2.14	0.036
Groups 3 & 1	0.28	57	0.09	0.929

Tables 14 and 15 recap the information on scores for Groups 1 and 2, facilitating comparison with Group 3. While all performed better after instruction, Group 3 achieved the greatest improvement ($M = 2.38$, $SD = 0.83$) and Group 2 the least ($M = 1.78$, $SD = 0.95$). Changes in test scores were submitted to a one-way ANOVA (Table 16). Levene's test (Table 17) shows that the group variances are equal, $p > 0.05$. There was a non-significant effect of teaching method on differences of students' pronunciation improvements with a medium effect size, $F(2, 57) = 2.937$, $p > 0.05$, $w = 0.26$. However, planned contrasts (Table 18) revealed that combined instruction significantly increased students' pronunciation performance compared to instructional software, $t(57) = 2.14$, $p < 0.05$ (one-tailed), while the effectiveness of combined instruction was similar to that of human-aided instruction, $t(57) = 0.09$, $p > 0.05$ (one-tailed).

Table 19: Descriptive Statistics for Score Differences between Posttest and Pretest on Different Pronunciation Aspects of Participants in Groups 1, 2 and 3

Group	Aspect	*M*	*SD*	Range	Minimum	Maximum
Group 1 (*n* = 20)	Vowels, consonants	0.625	0.46	1.0	0.0	1.0
	Diphthongs, consonant clusters	0.525	0.47	1.0	0.0	1.0
	Linkage of sound	0.125	0.32	1.0	0.0	1.0
	Word stress	0.425	0.41	1.0	0.0	1.0
	Sentence stress, rhythm	0.475	0.44	1.0	0.0	1.0
	Intonation, pitch	0.175	0.34	1.5	–0.5	1.0
Group 2 (*n* = 20)	Vowels, consonants	0.475	0.41	1.0	0.0	1.0
	Diphthongs, consonant clusters	0.475	0.47	1.0	0.0	1.0
	Linkage of sound	0.200	0.41	1.5	–0.5	1.0
	Word stress	0.225	0.41	1.5	–0.5	1.0
	Sentence stress, rhythm	0.275	0.41	1.5	–0.5	1.0
	Intonation, pitch	0.150	0.29	1.0	0.0	1.0
Group 3 (*n* = 20)	Vowels, consonants	0.500	0.49	1.0	0.0	1.0
	Diphthongs, consonant clusters	0.400	0.50	1.0	0.0	1.0
	Linkage of sound	0.200	0.30	1.0	0.0	1.0
	Word stress	0.475	0.47	1.0	0.0	1.0
	Sentence stress, rhythm	0.425	0.47	1.0	0.0	1.0
	Intonation, pitch	0.375	0.46	1.0	0.0	1.0

Table 20: Paired-samples *T*-test Results for the Segmental and Suprasegmental Scores of Group 3

Pair	*M*	*SD*	*SE*	*t*	*df*	Sig. (2-tailed)
Segmental aspect	0.450	0.33	0.07	0.90	19	0.380
Suprasegmental aspect	0.369	0.17	0.04			

$p > 0.05$

Table 21: Results of MANOVA on Different Aspects of Pronunciation for Groups 1, 2, and 3: Multivariate Test Results

	Value	df_1	df_2	*F*	Sig.
Pillai's trace	0.139	4	114	2.128	0.082

$p > 0.05$

Table 22: Univariate Test Results

	Source	*MS*	*SS*	*df*	*F*	Sig.
Contrast	Segmental aspect	0.09	0.18	2	1.008	0.372
	Suprasegmental aspect	0.12	0.25	2	3.291	0.044
Error	Segmental aspect	0.09	4.95	57		
	Suprasegmental aspect	0.04	2.12	57		

Table 23: Contrast Results

Contrast	Variable	Sig.
Groups 1 & 3	Segmental aspect	0.185
	Suprasegmental aspect	0.265
Groups 2 & 3	Segmental aspect	0.789
	Suprasegmental aspect	0.013

Table 19 displays the score means, standard deviations, and ranges of score differences between post- and pretests on different aspects of pronunciation for all students. For Group 3, differences of means for these six items were not as great as for Groups 1 and 2. The increases on word stress ($M = 0.475$, $SD = 0.47$) and individual sounds ($M = 0.500$, $SD = 0.49$) were similar. It is also noteworthy that the minimum increase of the scores for each item was 0.0 without negative values, meaning that these 20 students gained improvement not only on the general quality of pronunciation, but also on different aspects of pronunciation. A paired-samples *t* test was conducted to explore whether combined instruction had different effects on the segmental and suprasegmental aspects of participants' pronunciation (Table 20). Group 3 achieved better performance on segmental aspects ($M = 0.450$, $SD = 0.33$) than suprasegmental aspects ($M = 0.369$, $SD = 0.17$). This difference was non-significant $t(19) = 0.90$, $p > 0.05$, $r = 0.20$. Analysis by MANOVA was undertaken to provide more information about the effect of instruction method on various aspects of pronunciation performance: results (Table 21) demonstrate a non-significant effect of the three modes of instructions on the general pronunciation performance (combination of segmental and suprasegmental aspects), which is in accordance with the results of ANOVA, Pillai's Trace = 0.139, $F(4, 114) = 2.128$, $p > 0.05$. Univariate results (Table 22) show a non-significant effect of different instructions on improvement of segmental aspect, $F(2, 57) = 1.008$, $p > 0.05$; however, all groups made significantly different progress in suprasegmental aspects of pronunciation, $F(2, 57) = 3.291$, $p < 0.05$. Contrasts results (Table 23) show where the significance lay. Improvement in suprasegmental aspects of pronunciation for Group 3 is significantly larger than that of Group 2 ($p = 0.13$).

This evidence in favor of a combined approach in terms of performance urges a return to the data on attitudinal change. How does the combined method compare with software-alone or teacher-alone approaches where attitudinal change is concerned? Repeated-measures ANOVA showed that the three instruction types did not differ significantly in terms of attitudinal changes and that Group 3 had the largest increase of means. Table 24 gives further details including score means, standard deviations, and ranges of change for the attitude surveys. The mean increased score for Group 3 was 5.3, which was higher than that of Group 1 ($M = 4.4$) and Group 2 ($M = 4.2$). That is, students receiving combined instruction underwent greater changes in attitude towards pronunciation. Meanwhile, planned contrasts (Table 25) revealed that combined instruction significantly improved attitudes towards pronunciation compared to instructional software, $t(57) = 2.09$, $p < 0.05$ (one-tailed), and human-aided instruction, $t(57) = 1.8$, $p < 0.05$ (one-tailed).

Table 24: Descriptive Statistics for Attitude Changes of Participants in Groups 1, 2, and 3

Group	*M*	*SD*	Range	Minimum	Maximum
1 ($n = 20$)	4.4	1.47	6	2	8
2 ($n = 20$)	4.2	1.94	7	2	7
3 ($n = 20$)	5.3	1.42	5	3	8

Table 25: Results of Contrast Tests on Attitudinal Changes

Contrast	Value	*SE*	*df*	*t*	Sig. (2-tailed)
Group 3 & 2	1.15	0.55	57	2.09	0.042
Group 3 & 1	1.00	0.55	57	1.81	0.075

The questionnaire illuminates the progress made by Group 3. Most participants regarded the software positively, 18 out of 20 stating a belief in its effectiveness, as opposed to 14 in Group 2. Recurrent opinions were "The software is easy to use," "It has many functions," "The pronunciation is very clear," "I feel free to speak loudly." At the same time, Group 3, like Group 2, complained about vocabulary difficulties and the somber graphics. Unsurprisingly, given previous results, students appreciated the teacher's personalized attention. The observation notes also explain Group 3's achievements. Concentration was better than in the other groups. In the first 20 minutes, the teacher's active instruction occupied learners. In the next 25 minutes, the novelty and convenience of the software attracted their interest. The evidence on performance, attitudes, and in-class behavior align to suggest that the combination of human-aided instruction and instructional software is best for young learners of pronunciation.

Discussion

This study asked how pronunciation software could benefit young Chinese EFL students at lower-intermediate level. First, we find that instructional software can improve pronunciation scores. In Group 2, software alone, its effects were seen to be greatest for performance on individual sounds and sound clusters. Many of the features lauded in the literature attracted positive comments from participants. The "consistency and patience" of software (Beatty, 2013, p. 98) were strongly affirmed: participants could listen to models, imitate, and practice repeatedly. Those who were too shy or embarrassed to solicit the teacher's help could simply consult the software (Roed, 2003). However, unexpectedly, the control group, taught only by a teacher, saw greater improvement in pronunciation performance scores than that using instructional software alone.

This study confirmed the correlation between positive attitudes towards pronunciation, stronger motivation, and better achievement noted by Suter (1976) and Elliott (1995). In terms of extrinsic motivation, our participants were typical, young, Chinese EFL learners. With no need to score well on pronunciation in examinations, or to produce comprehensible or intelligible English outside the classroom, they tended to undervalue pronunciation at this important point of learning. However, this study shows that attitudes towards pronunciation could be improved with explanations of the importance of pronunciation and when the teacher's direction and the software provided a positive experience of pronunciation training. This, we predict, would lead to long-term improvement in performance.

The fourth research question, regarding the potential of the combination of a teacher and instructional software, was motivated by the researchers' expectation that teachers benefit young learners. The unexpected answer to RQ2, that human-led instruction produced better performances than instruction by software, already contraindicates the software-alone model when competent instructors are available. The combined-instruction group, however, allowed the discovery that it was the combination of both modes, which was the optimal pedagogical model in terms of both improved attitudes and performance. Software supplies the many advantages we have seen, but for young learners with a lower-intermediate level of proficiency and limited skills in autonomous learning, teachers' help is critical.

Conclusion

This project tested a specific software package in a particular setting. Further research is needed to see if other software would yield similar results, and indeed if the results would hold for the same package but a wider group of participants. A limitation of this study is that, in order to compare the efficiency of human- and software-aided instruction, time on task was controlled, meaning that characteristic features of software use, individual pacing, and practice in learners' own time were excluded. Would unlimited access to software change the results? This remains to be explored. Given that this study lasted only two weeks with 45 minutes' instruction per day, only limited progress in pronunciation proficiency was possible. A longitudinal study could test the trends identified here, exploring whether the patterns of relative effectiveness of instruction modes were sustained. Our female-dominated Groups 1 and 3 achieved greater progress than Group 2: future studies could investigate gender differences with respect to results and enthusiasm for technology. Purposively composed groups could also control for or examine interactions between mode of instruction, change in performance or attitude, and initial language level. Finally, while the survey adapted from Elliot's PIA was simple to administer, a study focusing on attitudinal change should avoid questions couched entirely positively to avoid the effect of participants answering to please the researcher.

The demonstrated superiority of teacher-led instruction over instructional software suggests that software design should attempt to reproduce the positive aspects of human interaction, such as individualized corrective feedback. Less ambitiously, software should include other features revealed as desirable by the participants in this study, and which currently exist, if not as features of the particular package tested, such as a built-in dictionary, or a scoring system to motivate progress. Appealing colors, animations, and games also encourage young learners. Finally, while students' progress on the segmental aspects of pronunciation was encouraging, teaching suprasegmental aspects requires further work.

Instructional software can help remedy the neglect of a critical skill, pronunciation, but it is teachers who can create the conditions whereby that potential can be realized. This study has shown them to be indispensable in pronunciation teaching for young learners, both as behavior managers and as instructors. It is therefore imperative that teachers receive adequate training to do their part, including work on their own pronunciation, on teaching techniques for pronunciation, and on the strategic integration of technology into the curriculum.

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Notes

1. The criteria included all the possible advantages of software based on previous studies (Levy & Stockwell, 2006).
2. Chinese to English translation by Gao.
3. Data on pronunciation performance in Group 3 (combined instruction) are discussed in the following section on the optimal pedagogical model.

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Appendices

Appendix 1. Rating Scale

Adapted from Seferoğlu (2005)

1 = has no communicative efficiency
2 = has very limited communicative efficiency
3 = has partial communicative efficiency
4 = has almost full communicative efficiency
5 = has full communicative efficiency

1. Individual sounds: vowels and consonants	1	2	3	4	5
2. Diphthongs and consonant clusters	1	2	3	4	5
3. Linkage of sounds	1	2	3	4	5
4. Stress pattern in polysyllabic words	1	2	3	4	5
5. Sentence stress and rhythm, weak forms	1	2	3	4	5
6. Intonation and the use of varying pitch	1	2	3	4	5

Appendix 2. The Pronunciation Attitude Inventory

Adapted from Elliott (1995).

Please read the following statements and choose the response that best corresponds to your beliefs and attitudes.
Please answer all items using the following response categories:

5 = always or almost always true of me
4 = usually true of me
3 = somewhat true of me
2 = usually not true of me
1 = never or almost never true of me

1. I'd like to sound as native as possible when speaking English.
2. Acquiring proper pronunciation in English is important to me.
3. I will be able to speak English with a good accent.
4. I believe I can improve my pronunciation skills in my English.
5. I believe more emphasis should be given to proper pronunciation in class.
6. One of my personal goals is to acquire proper pronunciation skills and preferably be able to pass as a near-native speaker of English.

7. I try to imitate English speakers as much as possible.
8. Communicating is much more important than sounding like a native speaker of my English.
9. Good pronunciation skills in English are as important as learning vocabulary and grammar.
10. I want to improve my accent when speaking my English.
11. I'm concerned with my progress in my pronunciation of my English.
12. Sounding like a native speaker is very important to me.

Appendix 3. Questionnaire

1. Do you think this software is useful for you? 你认为这套软件对你有用吗？
2. Which advantages of the software content and design can help your English pronunciation learning? 你认为这套软件在教学内容以及设计上面有什么优点能帮助你语音的学习？
3. What are the disadvantages of the software content and design? 这套软件在教学内容以及设计上有什么缺点？
4. How are a real teacher and the software different? 你认为软件和老师有何不同？