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Research Article

Integration of an AI-Based Platform and Flipped Classroom Instructional Model

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This article aims to evaluate a flipped class teaching model based on an AI (artificial intelligence) Language Learning Platform. The platform adopts mainstream collaborative filtering and BPMF (Bayesian Probabilistic Matrix Factorization) and big data management methods to provide students' detailed performance analysis reports and push recommendation exercises. The researcher reconciled the flipped teaching model with the AI-based language learning platforming in an experimental class and conventionally in a control class. At the end of the semester, the researcher compared students' performance as well as their attitudes toward the course between the two classes through a postexam paper and a questionnaire. Combining quantitative and qualitative methods, the survey shows that although the AI-based language learning mode failed to significantly increase students' English listening scores, compared with the students in the traditional class, those receiving the new mode held a more positive attitude toward their English listening experience, especially in regard to learning interest, study autonomy, and class involvement. The flipped class mode not only relieved students' partial cognitive processing workloads in class, but also boosted their confidence to engage in classroom discussion by reducing their nervousness through before-class preview. The AI-based language learning platform mainly performs monitoring and tutoring functions which facilitate the flipped class instruction. This study proposes a new flipped teaching model and proves it effective, indicating that for the flipped class learning mode to be successful, it is of importance to integrate face-to-face classroom instruction with the AI-technology-assisted online learning experience in a way that they can coherently support each other.

1. Introduction

In the conventional classroom where the instructor, as the knowledge conveyor, dominates the classroom, students passively receive information from the lecture by taking notes. Following the lecture, outside the classroom setting, students try to memorize, analyze, and understand the message and then apply the knowledge. The emergence of the flipped classroom teaching model provides great challenges to the traditional teacher-centred classroom mode. Since Baker coined the term "flip" in 2000 and Salman Khan first uploaded microclasses in 2004, flipped classroom has gradually gained popularity worldwide.

The flipped class, classified as blended or mixed learning mode, puts part of classroom content outside of the classroom that can be online learning or video learning or both. The flipped classroom requires students to complete knowledge assessments relevant to the course content, and the classroom becomes teacher-student interaction, students-student interaction, answering questions and solving problems, and practical applications. With the place, students take the initiative to learn, while the role of teachers changes from the authority of the class to the guidance of students learning [1].

The flipped classroom teaching model features a flexible learning environment, student-centred classroom culture, and thoughtfully selected classroom teaching content. Out-of-classroom content delivery can leave low-level learning processes such as memory and basic comprehension tasks before or after the class and free up the in-class time for high-

level cognitive processing such as analysis, evaluation, application, and creation. Flipped classes simultaneously encourage students to independently work through course contents at their own pace, hence promoting their autonomy and learning efficiency.

Many studies have been conducted to examine the effects of flipped classroom on learning outcomes compared with the traditional classroom, and the flipped classroom has been proved to be more effective than traditional lecture-based instruction in improving students' learning experience and outcome due to the efficient use of class time [2], more active classroom engagement [3, 4], more student-teacher and student-student interactions [5, 6], addressing multiple learning styles [7], and reflective learning [8]. In spite of the obvious advantages, the flipped classrooms still encounter some issues and challenges. A recent meta-analysis of 198 flipped classroom teaching experimental studies published before 2018 found that flipped classrooms have a moderate effect on students' learning in general [9]. One prominent problem is that not all the students in the class are engaged in and even may disregard preclass activities, which will obviously influence the efficacy of the flipped class model. Even though most of the flipped classroom approaches include assessment for preclass activities to the course grading system as incentives, it still cannot guarantee students' devotion to preclass activities since students may merely complete the work but not necessarily with devotion or enthusiasm and the instructor may be unable to monitor the process of students' preparation. The rapid development in AI technology over the past few decades exhibits a totally new world of possibilities as to EFL teaching and learning which can solve the problem of the flipped classroom.

AI-based language learning platform has the function of tracing, monitoring, and recording users' behavior, which facilitates the accurate assessment of students' study, hence promoting their external motivation to complete preclass activities.

The purpose of this research is to develop an AI-based flipped classroom model for implementation in the course of English listening comprehension in the high education context and evaluate the efficacy of the model.

2. The AI-Based English Listening Learning Platform

2.1. Functions of the Platform. The English Listening Learning Platform is an online open course service platform developed by Beijing Xueyan Huizhi Network Technology Co., LTD. With MOOC characteristics of modularization, openness, and cloud services, and innovative hybrid teaching concepts, the platform adopts mainstream digital technologies along with big data analytic artificial intelligence.

The platform has six sections: online course, vocabulary, listening contest, teaching analysis, downloadable resources, and personal centre. The online course is divided into 4 gradients according to the topic difficulty coefficient, with 10 topics relevant to students' life under each gradient, covering campus life, friends making, etc. Under each topic, there are seven sections: warm-up, listening tasks, vocabulary and sentences, listening skills, news English training, English songs and videos, and other supplementary materials. The first four parts of listening training take into account the latest CET4 and CET6 listening comprehension training and the last two parts allow students to learn English using authentic materials for educational entertainment to improve their cross-cultural communication ability.

The system includes an intelligent diagnostic function and provides detailed learning progress reports for both students and teachers. The background system adopts big data management technology to synchronously track, record, and evaluate the students' listening and speaking training in real time, which is convenient for students to make full use of fragmented time. Besides their scores, students can also check the accuracy, learning duration, the highest score, and average score of the class. As long as students complete 80% of the exercise progress, the system will automatically provide a learning report, presenting a detailed analysis of students' mastery of the knowledge points, problem-solving skills, and question types. At the same time, the system will provide accuracy rate and diagnosis details. Diagnosis is detailed to the specific knowledge points, problem-solving skills, and exercise types. At the same time, the system will push targeted exercises to address their weaknesses according to the statistics of students' learning situation. The platform adopts the formula Final = score + means/times + 1 to encourage multiple practice attempts.

2.2. Evaluation Model. The system automatically pushes relevant extended exercises according to each student's learning situation, in order to consolidate his/her unfamiliar knowledge points.

The platform uses collaborative filtering and BPMF (Bayesian Probabilistic Matrix Factorization) methods to construct multidimensional sparse matrix based on three dimensions (knowledge points, skills, and question types) and weighs them accordingly. This multidimensional sparse matrix is decomposed into two low-dimensional matrices or factor matrices by matrix factorization, which, respectively, represent knowledge matrix and question matrix. Then the similarity between any two rows/columns in the question type matrix is calculated with cosine formula $\sin(I\_i, I\_j) = \cos(I(I), I(j))$ (I represents the factor and i and j represent the serial number of any two rows or columns) to calculate the extended questions to be recommended.

Collaborative filtering model contains the data of M (the number of questions) and N (the number of question types). M and N are not a one-to-one mapping relationship and only part of the sets M and N is connected, producing the score. Then, a machine-learning-based model can use partial data to predict the rest of the data with no relationship and recommends the most relevant topics to users.

The recommendation problem can be solved by a machine-learning-based model. Machine learning can establish an appropriate model by analyzing users' basic information and behavior habits. The model can be used to understand

learners' learning patterns, predict their learning performance, and push personalized learning resources accordingly. Then the real-time data and the analysis during the learning process can in turn help to enact adjustments.

The scoring matrix can be decomposed into the product of two low-dimensional matrices, described as $R = UV$, where matrix U has D rows and N columns, describing the attributes of N questions, and matrix V has D rows and M columns, describing the attributes of M question types, with R as the observation value. According to the properties of matrix rank, the rank of R does not exceed U, and the minimum size of V is D.

In practice, such a perfect decomposition is impossible due to the presence of system noise, and R contains many unknown elements. The problem is hence transformed into the following: Decompose an approximate matrix $\hat{R} = UV$, requiring the approximate matrix $\hat{R}$ in the observed scoring part to be as similar as possible to the observation matrix R. In order to prevent overfitting, some form of constraint on U and V is required. In Bayesian terms, R is the observed value, and U and V describe the internal characteristics of the test.

The following procedure will mine the content based on the association rules. Learning results from a scoring matrix A according to the dimensions of the user's study time t, accuracy p, and the number of repeated questions c, the study effect constitutes a rating matrix A.

The system will evaluate users' knowledge mastery level f through the Apriori algorithm and FP growth algorithm. The system then looks for the same frequent data set as f, which is described with support level and reliability and the results are fed back to users as a reference and used as a basis to decide whether to recommend the relevant extension questions.

3. Methodology

3.1. Research Questions. The purpose of the present study is to answer two questions: (1) Do students demonstrate better performance from the class delivered using the AI-based flipped class in comparison with students who learn from a traditional lesson paradigm? (2) Do students who attend the class delivered using the English Listening Platform rate the quality of their instruction differently from those taught using a traditional paradigm?

3.2. Participants. This study was conducted in two classes with 61 freshmen who are aged between 17 and 19 and Chinese majors enrolled in a four-credit listening comprehension course as a requirement for their BA degree. None of the participants have international study experience. Of the total, two students failed to participate in the examination and therefore were not included in the data for pre- and posttests. Students were identified as less or more skilled English learners based on their performance on the listening pretest. Those scoring above the mean (80) were classified as higher-level listeners, and those scoring below the mean were classified as lower-level. The information of the participants is shown in Table 1. The same instructor taught both the experimental and the control groups, and although the teaching methodology for listening differed, both groups used the same textbook.

Table 1: Distribution of students—two classes.

Class	Number of participants	Gender	English background
Experimental	30	Male 5 Female 25	10 years
Control	31	Male 5 Female 26	10 years

3.3. Instruments

3.3.1. Pre- and Posttests. Students' listening competency was assessed using a listening comprehension test. The internal consistency of this test is high: $\alpha = .94$.

Subtests include (1) eighteen short conversations followed by a multiple choice question (36 points); (b) two long conversations followed by seven multiple choice questions (14 points); (c) three passages followed by ten questions (20 points); (d) spot dictation with ten blanks to fill in (20 points); and (e) video watching followed by five questions to answer (10 points). Listeners heard the stimuli in the first three subtests only once; the texts for the last two subtests were heard three times. The test required approximately 60 minutes to complete.

3.3.2. The Questionnaire. To investigate how students perceive the AI-based flipped classes, we administered a questionnaire to survey students' views toward the course. All the 61 students were invited to submit a questionnaire (Table 2). The questionnaire consists of 11 Likert Scale questions with five degrees from 1 (strongly disagree) to 5 (strongly agree). We conducted all quantitative data analysis in SPSS, version 19. Here, we present continuous data as mean ± standard deviation (SD). A two-factor ANCOVA test is used to compare students' responses between the experimental class and the control class and statistical significance was set at $\alpha = 0.05$.

The questionnaire was first provided to 15 students chosen from one class of the same university to check its clarity and determine its reliability. It was reliable at 0.751 Cronbach's Alpha, indicating that the satisfaction scale designed in this study has a high internal consistency. To evaluate the questionnaire content validity, the questionnaire was reviewed by three experts in English teaching who provided their suggestions for improving the content validity of the questionnaire.

3.4. Research Procedures. Prior to the experiment, all the participants were evaluated by an English listening pretest to assess their English listening comprehension level. Both classes received instructions from the same teacher for the

Table 2: Comparison of course evaluation between experimental class and control class.

Course evaluation questions	Mean ± SD for exp. class	Mean ± SD for control class	p-value
1. I am very interested in English listening and enjoy the current English listening learning process	3.37 ± 0.65	3.18 ± 0.55	>0.05
2. I do not feel nervous when answering questions in English listening class	3.95 ± 0.46	3.21 ± 0.37	<0.05
3. The teacher used appropriate and effective teaching methods in English listening class	3.85 ± 0.53	3.42 ± 0.39	<0.05
4. I have the habit of previewing before English listening class	4.12 ± 0.22	3.38 ± 0.45	<0.05
5. I have to prepare for class in order to follow up the English listening class	3.95 ± 0.43	3.62 ± 0.67	<0.05
6. The teacher encourages active participation in English listening class	3.87 ± 0.36	3.48 ± 0.45	<0.05
7. I participate and engage in discussions in English listening class	3.75 ± 0.56	3.21 ± 0.37	<0.05
8. In-class discussions with my peers enhanced my English listening level	3.55 ± 0.43	2.12 ± 0.27	<0.05
9. I think my autonomous study ability in English learning has been improved	4.07 ± 0.42	3.38 ± 0.55	<0.05
10. My listening skills have been improved	3.63 ± 0.66	3.45 ± 0.69	>0.05
11. What is your overall rating for this course?	3.66 ± 0.56	3.59 ± 0.51	>0.05

next sixteen weeks with different methods. At the end of the semester, both classes were asked to complete a posttest. In the interest of clarity, the pretest was intended to ensure that the two classes were equal in language competency and the two tests are not equal in difficulty, so that the researcher did not compare the difference between the pre- and posttests of each class to assess students' improvement in English competency.

At the beginning of the course, students of both classes acquired the learning materials from the teacher, including the course syllabus, course agenda, PPT slides, videos and course assessment system or standards, etc., and knew clearly the requirements of the course and the objectives of the course. At the same time, the teacher introduced the English Listening Learning Platform to the students of the experimental class and familiarized them with the platform's functions to integrate the platform with the course.

3.4.1. Preclass Activities—Listening as Comprehension. Preclass activities are task-based and have specific objectives. The purpose of this stage is for students to complete the comprehension questions in each unit on the platform required by the teacher. The students will be marked and get immediate feedback from the system, including the explanation of the wrong answers. They can repeat the practice and the system will record the highest score. At the same time, according to students' performance, the system will further push relevant extended exercises automatically in order to rectify students' weak points, but the students have the space to choose the content they are interested in among the materials on the platform while completing the compulsory tasks. The teacher can supervise students' learning process through the monitoring function of the platform as well as the statistics such as the score, study time, and accuracy.

3.4.2. In-Class Activities—Listening as Comprehension as well as Production. In class, the teacher carried out the targeted classroom teaching objectives based on the objectives of the unit as well as the practice problems reflected on the platform and the issues posed by students. Firstly, group discussions were used so that students can communicate with each other to explore the answers to some questions, during which process students were able to develop cooperation and critical thinking abilities while acquiring knowledge and training language skills. Following the discussion, the teacher would further explain issues for which students were unable to reach a consensus. Through this student-centred and interactive method, the enthusiasm and motivation of students can be thoroughly stimulated.

Afterward, the teacher played a different video or audio related to the topic of the present unit. At this stage, students listened to a passage three times. Before students listened to the audio for the first time, they were given the title of the passage and then brainstormed what information they would hear on the following on the basis of the topic. After they listened to the passage for the first time, they were asked to check their predictions and provide evidence about how they either confirmed or dismissed their predictions.

The second listening round can be noticing activities or restructuring activities. The purpose of noticing activities is to use the listening material as the basis for language awareness. Students were asked to complete certain exercises such as identifying differences between what they heard and a printed version of the passage, or filling in the blanks with certain missing key words. Restructuring activities can be oral or written tasks, involving productive use of selected items from the passage. Students read scripts in pairs, completed sentences using expressions and other language items in the text, and used some targeted words or expressions from the text to role play.

In class, the instructor also asked students to perform word recognition practice. One difficulty students often encounter with English listening is word recognition, because they are unable to parse the English speech stream and understand the spoken forms of words they know in written form [10]. Word recognition problems originate from the way English sounds are compressed closely together or stretched in speech [11], while EFL learners tend to segment based on their native language segmentation rules [12]. Consequently, Chinese EFL listeners appear to be under a rather unfavorable English language learning circumstance in this respect since Mandarin, as a syllable-timed language,

has different rhythms and tones from English, which is a stress-timed language [13]. Thus, in this flipped class, word recognition activities were devised to help learners recognize lexical boundaries by sensitizing the students to some segmentation cues, such as weak forms, link-ups, and contractions. Two exercises were designed at this stage. The first exercise asked students to listen to sample sentences, pay attention to the weak forms, link-ups, and contractions, and then repeat the sentences. The second exercise lets the students listen to a dialogue and fill in the blanks with the targeted words. Then the teacher discussed with students how the targeted words are read in the dialogue.

3.4.3. Postclass Reflection and Assessment. At the end of each unit, students submitted their reflection on the unit, including their gains, difficulties, and confusions as well as their suggestions for the class. The teacher communicated with students through WeChat to give solutions or feedback to students. Through the autonomous analysis of the quizzes by the platform, the teacher can have comprehensive information of students' performance so as to position the weak links of students and be more effective as well as efficient in class.

4. Results

4.1. Comparison of the Experimental and the Control Classes in English Listening Performance. Our first and second hypotheses concerned the degree to which AI-based flipped class might result in variance in students' listening performance. We hypothesized that the class receiving experimental treatment would outperform the control class on the posttest of listening comprehension. In addition, we hypothesized that listeners who were less skilled at the outset of the experimental class would show a greater improvement in achievement than their more skilled counterparts.

In order to examine these two hypotheses, a two-factor ANCOVA was administered with SPSS. The independent variables consisted of the class (experimental and control) and the level of listening ability (high-level and low-level). In order to control any initial differences in the participants' listening ability, pretest scores were used as the covariate.

To meaningfully interpret the univariate F tests for the different groups, we determined whether any statistical assumptions underlying the use of ANCOVA were violated in the dataset. An examination of Levene's test of equality of error variance, which can be seen in Table 3, demonstrated that the data satisfied the condition of homogeneity of variance; therefore, postlistening error variance was equal across groups ($F = 2.373$; $p = 0.080$). Moreover, the results of the tests of between-subjects effects (i.e., the test of the interaction between the independent variable class and the covariate students' pretest scores) as shown in Table 4 demonstrated that the assumption of homogeneity of regression slopes was successfully met, $F = 10.87$, $p = 0.42$. The results of tests of the between-subjects effects were further examined for statistical significance of the main effects of the independent variables, class and listening competency.

Table 3: Levene's test of equality of error variance.

F	df_1	df_2	Sig.
2.373	3	55	0.080

Test the null hypothesis that the error variance of the dependent variable is equal across groups. a. Design: pretest + class (experiment/control) + group (high-level/low-level + class ∗ group).

Table 4: Descriptive statistics for posttest.

Source		Mean	SD	N
Experiment	High-level	83.41	3.063	17
	Low-level	73.64	7.724	11
	Total	79.57	7.162	28
Control	High-level	83.27	2.789	15
	Low-level	70.19	10.432	16
	Total	76.52	10.109	31
Total	High-level	83.34	2.892	32
	Low-level	71.59	9.419	27
	Total	77.97	8.894	59

Table 5 shows the mean and standard deviation of students' posttest scores for the experimental and the control group at each listening competency level (high-level and low-level). The estimated marginal mean on posttest listening score for the experimental class was 79.57, higher than that of the control class 77.97, but as evidenced in Table 5, these differences were not statistically significant ($F = 0.096$, $\eta_2 = 0.002$, $p = 0\ 758 > 0.05$), suggesting that AI-based instruction did not result in the significant variance in students' listening achievement between the two classes, with η_2 of 0.002, indicating a fairly weak effect.

For the high-level listeners in the experimental class, the mean ($M = 83.41$) was slightly higher than that of those in the control class ($M = 83.27$), but for the low-level listeners the difference is much wider with ($M = 73.64$) and ($M = 70.19$), respectively, for the experimental class and the control class. It seems that the teaching methodology influenced the lower-level listeners more compared with the high-level listeners, and the small sample does not allow a pair comparison of students' performance for both levels, so that the statistical significance cannot be ascertained.

In summary, the results of the analyses related to the first two hypotheses demonstrate that although the group receiving the AI-based flipped class outperformed the control group on the listening comprehension test, especially for the less skilled listeners in the experimental class when compared with their counterparts in the control class, the difference is not statistically significant.

4.2. Comparison of Students' Attitudes and Perceptions of the English Listening Classroom. This section evaluates students' perception of their English listening improvement and the effectiveness of the English listening class.

From Table 2, it can be generally observed that students from both classes are satisfied with their class since students evaluated most of the questions with a rating higher than 3,

Table 5: Tests of between-subjects effects.

Source	d*f*	Mean square	*F*	Sig.	Partial eta squared
Corrected model	4	796.737	30.710	0.000	0.695
Classes (experiment/control)	1	2.479	0.096	0.758	0.002
Listening competency	1	231.399	8.919	0.004	0.142
Classes ∗ competency	1	11.304	0.436	0.512	0.008
Prelistening	1	1087.051	41.900	0.000	0.437

R square = 0.695 (adjusted R square = 0.672) from SPSS result.

except for question 8 from students of control class. It demonstrates that students from the flipped class benefited from class discussion, while students from the traditional class did not obtain the same benefits probably due to the reduced opportunities for live discussions in the control group taught by traditional methods.

For the rest of the questions, even though students from both classes viewed their classes positively, students from the experimental class were more likely to react positively to their AI-based flipped classroom than students from the control class with their traditional classroom from class attraction, learning motivation, relaxing learning environment, student engagement, autonomous study ability cultivation, and learning effect. Students rated the experimental class significantly higher than the control class except for the first question related to students' interest in English listening and the last two questions related to their improvement in the course and their overall impression on the course. Even for these aspects, students in the experimental class still hold higher views toward the new approach compared with the traditional method, but the difference cannot reach statistical significance.

5. Discussions

5.1. Accounting for Students' Achievements of English Listening Class. The mean scores of the posttest for the flipped class were higher than the regular class and students' perception of their listening skills and overall rating of the course for the flipped approach was slightly more favourable than that of the regular approach, but the results showed no significant difference. This result seems to contradict with previous studies that the flipped classroom contributed to students' English academic performance in general [14], English writing [15], English grammar [16, 17], English speaking [18], and English listening [19].

But actually, several studies reported a lack of strong evidence for the effectiveness of flipped learning in various disciplines. The systematic review of the flipped classroom in higher nursing education yielded neutral or positive academic outcomes and mixed results for satisfaction [20]. Indeed, although extensively studied over the years, there is still debate about the effectiveness of flipped learning in improving learner outcome as compared to traditional learning. Half of the studies on flipped class showed no improvement in exam scores [21] and the flipped approach was not significantly better than the traditional approach for delivering this course in terms of their achievement and their perception of the course [22].

5.2. Accounting for the Feasibility of the AI-Based Flipped Class. Although the feasibility is not reflected in the listening test results, our results suggest that this AI-based flipped class fostered learning and provided positive learning experiences for students, because students of the experimental class reported feelings of relaxation in class when answering questions.

5.2.1. The Feasibility of the Flipped Class. More students in the flipped class than those in the traditional class can feel the improvement in English listening through the class discussion, which might be attributed to two causes. Compared with the traditional class, students of the experimental class are more motivated to prepare before the class. To better process the content in class, students better make preparations before class. According to cognitive load theory, the process of learning imposes a load on the working memory that has finite processing capacity [23]. In class, students need to associate the new information with what is already stored in the long term memory. If the load exceeds what students can digest, their learning capacity will be low [24]. Introducing material in advance can reduce cognitive load, hence enhancing learning efficacy. The instructor can take the best of invaluable face-to-face class time and prioritize higher-order cognitive tasks.

The second cause is due to the active participation in class due to the feature of the flipped class. The flipping class instruction model means more than shifting part of the content outside of the classroom. The underlying ideology is to transform teacher-centred classroom instruction into a students-centred classroom, which considers students as active learners instead of passive knowledge receivers. There is evidence that the participants in the flipped classes spent more time and effort learning on their own compared to students in the traditional classes, which indicated that they participated more in the learning process. Furthermore, the research on listening comprehension shows that nervousness ranked top 5 among ten major listening problems that Chinese university students encountered [25]. By reducing their nervousness and boosting their self-confidence as indicated in the questionnaire, the preclass preparation is especially beneficial for students' engagement in English listening class.

5.2.2. The Role of AI-Based Language Learning Platform in the Model. The significance of AI technology in teaching and learning has been acknowledged by flipped class teaching researchers, which is increasingly utilized to facilitate outside-the-classroom learning in a flipped class

mode. There is evidence that if students in the traditional class extensively used similar resources with those in the flipped class such as videos and online resources, the differences between treatment and control groups might be blurred [26]. It has been proven that technology has a remarkable effect on students' English proficiency levels and attitudes toward learning English [27] as well as in speaking [28].

In this class design, AI-base language learning platform plays a significant monitoring and tutoring role. On one hand, the key to a successful flipped class is students' before-class preparation, but students' low engagement in the preclass activities is encountered by most of the flipped class designs. It is reported that around 70% of flipped classroom students did not prepare for a class [29] and even 39% of flipped classroom students skipped the preclass learning activities [30]. If students fail to complete the preclass learning activities, and the instructor follows the planned teaching procedure, the learning effect will be even worse than the traditional approach; but if the instructor reteaches the materials in class, this would render the entire flipped learning approach not different than a traditional class. In this experiment, the preclass activities can be measured and monitored through the AI learning platform by the instructor, which is considered as part of the course formative evaluation of the curriculum. In addition, students' learning motivation is also stimulated by the continuous improvement of scores. The instructor found that most of the students practiced the questions multiple times. Therefore, students are more motivated to form the habit of previewing and are able to achieve proficiency during repeated practice.

In addition, feedback information can help students to recognize the gap between their existing knowledge and their learning goals and clarify the direction of efforts. At the same time, teachers can supervise the students' study and help students to reflect on their own behavior. However, one disadvantage of the flipped class model is the lack of timely feedback available to students while watching instructional videos. Students are unable to ask questions and receive instantaneous feedback from teachers, as during in-class lectures [31]. In this experiment, the platform adopts mainstream digital technology and big data artificial intelligence analysis methods to analyze the weaknesses and strength of their study, diagnose their problems, and give students real-time feedback and material recommendation. In this way, students are encouraged to be more responsible for their own learning and do not rely solely on the teacher to provide information in the classroom as reflected in their evaluation of their autonomous study in the questionnaire. The system includes intelligent diagnostic functions and provides detailed learning progress reports for both students and teachers. Such timely feedback can also increase the opportunities for teachers to find problems in the teaching process, so as to improve the teaching method and continuously promote the improvement of teaching ability.

6. Conclusion

This research assesses a flipped English listening comprehension class teaching mode based on an AI Language Learning Platform. Combining quantitative and qualitative methods, the survey demonstrates that although the AI-based language learning mode failed to significantly increase students' English listening scores, compared with the students in the traditional class, those receiving the new mode of instruction held a more positive attitude toward their English listening class, especially in learning interest, study autonomy, and class involvement. Indeed, the flipped class mode requires students to prepare before the class, which can not only relieve partial cognitive processing workload in class, but also boost their confidence to engage in classroom discussion by reducing their nervousness through preclass activities. The AI-based language learning platform plays the facilitating role by monitoring students' before-class preview, analyzing their practice, and providing instant feedback. The contribution of this study is that it poses a new flipped class teaching mode and indicates the importance to integrate the face-to-face classroom instruction with the AI-technology-assisted online portion of the learning experience in a way that they can coherently support each other.

There are a few limitations in this study. First, this course only lasts one semester with sixteen weeks, but language improvement is a complicated process that needs time for learners to digest and reflect before the obvious improvement takes place. Second, the practice score graded by the platform allows repeated correction by users, which makes the data only influenced by practice frequency, without any correlation with students' English competency. Due to the limitations of the present study, further research is needed to have a more exhaustive study on the efficacy of both the improved blended teaching mode and the perfected language learning platform.

The future research should focus on longitudinal studies to observe the key factors affecting flipped classroom teaching effects and how to effectively develop the flipped classroom model according to different teaching situations with the improved language learning platform.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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