Design and Application of Computerized Adaptive Algorithm in Differentiated Teaching of Higher Vocational English

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Abstract
In recent years, the diversification of higher vocational enrollment has led to significant differences in students.With great differences in foreign language foundation, uneven quality, the imbalance of English teaching increased.The blended teaching mode is an important change in the way of learning in the information age, adopting the teaching mode of "online" + "offline", but students' differences have not received enough attention. Using computer adaptive algorithm technology to build a reasonable test model, and accurately push appropriate test questions to students with a difficulty appropriate to their ability level, it can quickly diagnose students' current learning level, so as to provide teachers with targeted differentiated teaching and provide strong support for students' independent learning.This paper discusses what the advantages of computerized adaptive algorithm on differentiated teaching are, how to carry out differentiated instructional design and implementation with the help of the computerized adaptive algorithm, what the effects are in the differentiated instruction supported by the computerized adaptive algorithm. In order to obtain rich data, quantitative and qualitative methods were used. Through actual research and practice, this project explores the use of computer adaptive algorithms in differentiated teaching, which can change the current situation that higher vocational English teaching has not fully realized students' differentiated learning.

Keywords: *Differentiated teaching, Computerized adaptive algorithm, Higher vocational English, Blended teaching mode*

1.INTRODUCTION

1.1. Problem Statement

In recent years, the diversification of higher vocational enrollment has led to significant differences in students. There are various forms such as ordinary college entrance examination enrollment, individual enrollment and counterpart enrollment. Judging from the results of the students' entrance examination, the gap is large, and it fails to show a normal distribution. With significant differences in foreign language foundation, uneven quality, the imbalance of English teaching has increased.

Differentiated teaching is an activity organized in the education system according to the differences in interest orientation and talent differences. Differentiated teaching emphasizes respecting the individual differences and actual conditions of students, and carries out targeted differentiated teaching, so that each student can make use of his strengths and avoid weaknesses and obtain the best development. [1]

The blended teaching mode is an important change in the way of learning in the information age, which has emerged and been promoted in higher vocational colleges. It combines the advantages of online teaching and traditional teaching, adopting the teaching mode of "online" + "offline", providing students with a wide range of learning resources on a platform for independent learning, and more opportunities for practical exercises and discussion. It is a more suitable model for subjects such as higher vocational English that require extensive language learning materials and practice skills.

However, at this stage, when higher vocational colleges use this model, whether online or offline, there

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is still a "one-size-fits-all" phenomenon, such as providing all students with the same teaching content, test questions, practice tasks on the learning platforms. And there is no effective grouping in the online and offline class, etc. In the actual teaching process, students with weak learning foundation still show relatively low learning interest and learning autonomy, low classroom participation. They are unwilling to cooperate with others and answer teachers' questions, so the learning effect is not satisfactory. Students' differences has not received enough attention and differentiated instruction has not been implemented . [2]

Computerized Adaptive Testing (CAT) is a new test form developed in recent years. This test is based on item response theory and uses computer technology as a means to form a set of theories and methods in question bank construction and question selection strategies.

In recent years, researchers have explored teaching modes supported by various technologies, but they have rarely linked these modes with the students' previous knowledge and skills, adapting to learning styles, respecting learning interests, and reforming the teaching structure. Therefore, it is very necessary to carry out differentiated teaching research with computerized adaptive algorithm.

1.2. Research Aim and Objectives

This study aims to explore design and application of computerized adaptive algorithm in differentiated teaching of higher vocational English. The differentiated instruction linked this mode with the students' previous knowledge and skills, adapting to learning styles, respecting learning interests, and reforming the teaching structure.

The research objectives of this project are given below:

(1) Identifying and evaluating the the advantages of computerized adaptive algorithm in differentiated teaching

(2) Identify and examine the differentiated instructional design and implementation with the help of the computerized adaptive algorithm

(3) Exploring and identifying the effects in the differentiated instruction supported by the computerized adaptive algorithm

1.3. Research Question

The research question are the questions which will be investigated and later answered by the researcher throughout the whole study. The research question of this study based on the problem statement is as follows:

(1) What are the advantages of computerized adaptive algorithm in differentiated teaching?

(2) How to carry out differentiated instructional design and implementation with the help of the computerized adaptive algorithm?

(3) What are the effects in the differentiated instruction supported by the computerized adaptive algorithm?

2.LITERATURE REVIEW

American scholar Gardner believes that human intelligence exists in many categories such as language, logic, space, movement, music, interpersonal, introspection, etc. Each student's intelligence has its own characteristics. And characteristics has a unique form of expression. [3] This prompts teachers to be people-oriented, and to carry out education and teaching that "prescribes the right medicine" for different students and different intellectual characteristics.

A well-known scholar of differentiation studies, Tomlinson put forward that the core idea of differentiated teaching is to regard individual differences of students as an integral element of teaching, and teaching to design differentiated teaching content, process and results based on students' different preparation levels, interests and styles, and ultimately promote all students get the development they deserve at the original level. Tomlinson identifies four areas in which teachers implement differentiated instruction: Content, Process, Product, and Learning Environment. [4]

The blended teaching is an "online" + "offline" teaching, combining the advantages of online teaching and traditional teaching. This changes the learning sequence and learning mode of students to a certain extent but students at different levels use the same online resources and participate in the same offline teaching activities, which is a big challenge for students with weak learning levels or poor autonomous learning ability. [5]

Looking at domestic and foreign literature, differentiated teaching rarely pays attention to vocational college students. It has not been examined in terms of meeting the different needs of college students. [6] Moreover, the various continuous assessment techniques were not fully practiced in the college. [7] Especially the practical application research of differentiated teaching supported by new technologies is even more scarce. In addition, there are few complete literature on the effectiveness of differentiated teaching of higher vocational English, and there are few quantitative studies that can reveal the effectiveness of

differentiated teaching in the class. Therefore, this study has positive significance for enriching the empirical cases of differentiated teaching in colleges and universities.

3.METHODOLOGY

In order to obtain rich data, quantitative and qualitative methods, or mixed methods, were selected for this study. This research adopted the method of literature research, survey, experimental and mathematical statistics research.

3.1. Literature Research Method

In the preparation stage of this research, the author consulted a large number of academic journal books, Internet and books related to the computerized adaptive algorithm, blended teaching mode and differentiated instructions.We found the weak points of research and grasped the latest research progress to establish the theoretical framework of this research.

3.2. Questionnaire Survey Method

An online questionnaire survey was carried out on the students to find out the students' needs for English in the process of learning.Questionnaire surveys were conducted on employees engaged in major occupational positions related to English to determine the English knowledge and practical skills required by the occupational positions.

3.3. Action Research Method

Two classes were chosen as the experimental objects, each class with about 100 students. Based on the teacher's teaching practice exploration, continuous exploration, reflection and summary in the teaching process.

3.4. Experimental Method

The research of this subject adopted the natural experiment method and conducted experimental research through actual teaching. The teaching objects were divided into the experimental group and the control group. One took the ordinary blended teaching mode and the other one took the differentiated instruction with the support of the blended teaching.

3.5. Mathematical Statistics

By comparing the questionnaire data before and after the experiment and the data measured before and after the experiment, using the geographic sample and cost sample comparison method, the obtained data were statistically processed by SPSS software, and the hypothesis of this study was verified.

4.RESULT AND DISCUSSION

This research was carried out in the 2020 Automobile Department of our school. The teaching object Automobile Marketing class 1 was set as the experimental group, and the 2020 automobile class 2 was set as the control group. Before the experiment, English test scores of the two classes were basically similar in each score segment. The number of people was basically the same, and the research error was reduced as much as possible.

The traditional method of arranging unified homework and using fixed test questions consumes a lot of time and energy for students, but cannot effectively improve students' learning ability and knowledge level. The computer adaptive testing technology is used to build a reasonable test model and provide students with accurate test results. Pushing appropriate test questions with difficulty appropriate to their ability level can quickly diagnose the current learning level of students, thus providing strong support for teachers to teach students in accordance with their aptitude and for students' autonomous learning. This study adopts the combination of Classical Test Theory (CTT) and Item Response Theory (IRT) to establish a test model and adopts the ca-MST model. Time and other aspects are different, but their evaluation scores can be expressed in a common evaluation system through test equivalence. At present, the expression methods of the evaluation system commonly used mainly include the score expression method based on the original score of the questionnaire and the score expression method based on the response mode. Because the score expression method based on the original score of the roll surface has the characteristics of model results that are close to common sense, less variable parameters, simple parameter estimation and equivalence methods, and stable equivalent results, so this study uses the original score of the roll surface. Score expression to evaluate.

In the construction of the ca-MST model, we first construct question banks of different difficulty and types. The difficulty of the test questions is graded, and four categories of test questions are established: easy, normal, difficult, and more difficult. And according to the characteristics of the computer system, set reminders that are easy and accurate to identify, mainly divided into single-choice questions, multiple-choice questions and true-false questions. And combine them into different question bank modules. The question bank module is divided into two parts: identification module and main test module. The identification module contains a certain number of questions of different difficulty. When the examinee answers the questions in the identification module, the computer system automatically judges the examinee's ability according to the examinee's correct answer rate and answering time, so as to automatically push the main test module

questions of different difficulty. The main test module is equipped with a judgment mechanism. When the test taker reaches a certain level, it will judge the test taker's level according to the test taker's answering accuracy rate and answering time, so as to push the question bank test questions of different difficulty. The tests are done with different volume-setting schemes. In the test of different difficulty groups, the main control points are set. For example, when a student is testing a question of general difficulty, when 1/3 of the question is completed, the system will judge according to the answering situation to continue to push the question of ordinary difficulty or change to push the question of simple difficulty or a higher degree of difficulty. High-difficulty test questions, this setting can correct and prevent the mismatch between the push difficulty and the examinee's ability caused by the deviation of the test-recognition module test questions due to special reasons, so as to more accurately judge the real ability of the students.

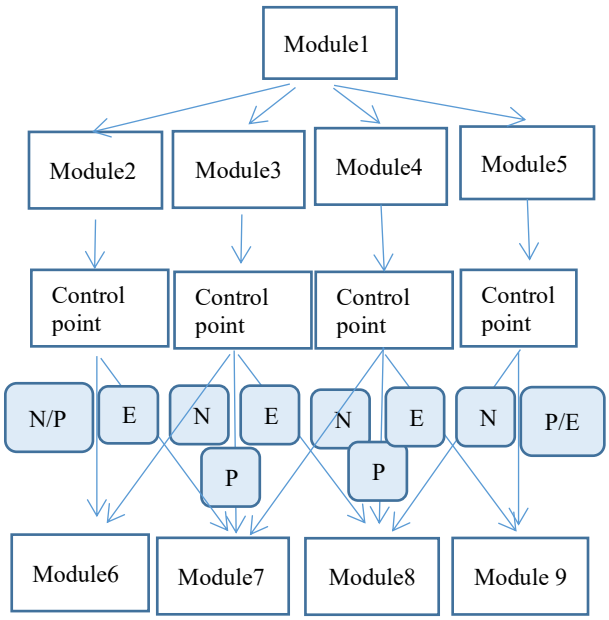

Figure1 Schematic diagram of computerized adaptive ca-MST mode (Note: N=No, P=Pass,E=Excellent)

Establish a score representation based on the raw score of the roll. Quantitative scores are made based on the percentiles of the percentage of students answering questions of different difficulty assessment knowledge correctly in the overall assessment sample. Using a single-parameter logistic model, there is a corresponding linear or non-linear relationship between the raw scores and the derived scores based on IRT. Before the ca-MST test, the raw scores and quantified scores of different test paths are confirmed by norm. The conversion relationship between the scores, and the score conversion relationship is embedded in the system, so that candidates can quickly obtain results. The advantage of using the IRT system is that the difficulty parameter value of the question and the candidate ability parameter value are in the same measurement system, and the parameter estimation of the model has the characteristics of invariance, which is convenient for evaluating the ability level of students.

For the experimental group,we took measures as follows:

(1) Designed and implemented the construction of online differentiated course resources. In the process of designing and developing online project-based tasks, for experimental classes, we produced a batch of excellent videos and teaching courseware with different levels of difficulty on the learning platform and phone mobile application according to the needs of different positions and the differentiated ability level of students. Students have the online test with computerized adaptive algorithm and they could have their own tasks according to their English level, interests and hobbies. Then they could form flexible groups, carry out cooperative exploration, group discussions, and submit works online.

(2) Implemented differentiated offline teaching. Teachers grouped students based on different online learning tasks in teaching activities. Students with different tasks selected online could join the discussion group in class, and students with different tasks formed different groups. Teachers assigned classroom activities with different levels of difficulty to students in different groups. For example, for groups with weak foundations, assigned tasks such as checking and reading vocabulary; assigned tasks such as translation or writing to students with good foundations.

(3) Reform student evaluation methods. The evaluation adopts a combination of formative evaluation and summative evaluation. In the formative assessment of students, the online and offline scores each account for half. Online mainly integrates online tests, coursework, course resources, online duration, and course duration. Offline refers to students' classroom group activities and attendance scores. Online and offline scores account for 40% of the total score, and the final assessment at the end of the term accounts for 60%.

Through the implementation of differentiated English instruction supported by the computerized adaptive algorithm, the degree of participation of students in class 1 on the online learning platform of our college was significantly better than that of the control group, including online learning time, topic discussion participation, number of watching learning videos. The mastery of the students, including the submission of assignments and the online test scores, were significantly better than those of the control group. Comparing the online learning results of the 2020 Automobile Marketing class 1 in the experimental group for two semesters, the online results in the second

semester were significantly better than those in the first semester. Comparing the 2020 Automobile Marketing class 1 of the experimental group and the control group 2020 Automobile Marketing class 2, the online performance of the experimental group that implemented differentiated online tasks was significantly better than that of the control group without differentiated tasks. Comparing the experimental group and the control group after the implementation of differentiated learning, whether the experimental group was compared with the first semester or the experimental group and the control group, it could be seen that after the implementation of differentiated teaching with computerized adaptive algorithm, the students' academic performance was significantly improved. There was a significant increase in the number of high-segment students. Therefore, we believe that after the implementation of the differentiated teaching model, students' learning initiative has been significantly improved, and students' English proficiency has been improved, prompting students to change from wanting me to learn to me wanting to learn.

Table 1 Comparison table between experimental group and control group

Project / points	Automobile Marketing class 1		Automobile Marketing class 2	
	First semester	Second semester	First semester	Second semester
90 - 100	0.00%	12.12%	0.00%	3.03%
80 - 90	18.18%	63.64%	15.15%	24.24%
70 - 80	60.61%	84.85%	42.42%	57.58%
60- 70	90.91%	93.94%	75.76%	81.82%
<60	9.09%	6.06%	24.24%	18.18%
Mean	70.0	80.4	66.0	68.5
median	72.6	83.1	67.2	71.0

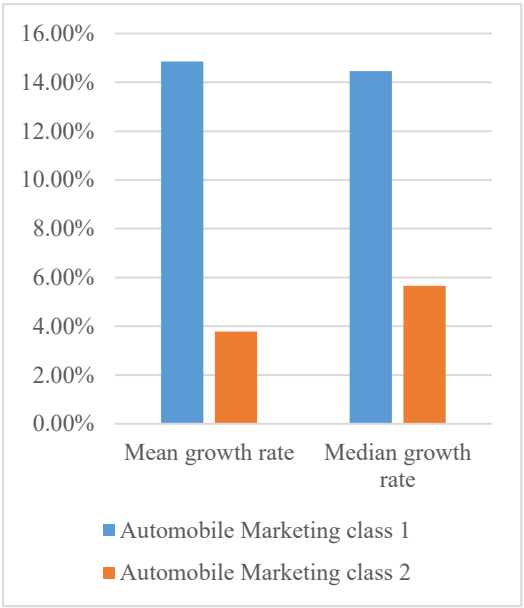

Figure 2 The mean and median growth rate comparison chart between Automobile Marketing Class 1 and Automobile Marketing Class 2

5.CONCLUSION

With the obvious differences of students, this paper takes advantage of the blended teaching mode, explores the ideas and methods for the development and construction of differentiated curriculum resources in higher vocational English, study the design and organization of differentiated teaching activities, and find online and offline differentiated evaluation methods. Through actual research and practice, this research explores a differentiated English teaching method supported by the blended teaching mode, which changes the current situation that our college's English teaching for students has not fully realized students' differentiated learning. It can give full play to the role of differentiated teaching in promoting students' autonomous learning. Students' interest and motivation in learning English can be stimulated, students' comprehensive English application ability can be improved .

The research on differentiated English teaching in higher vocational colleges supported by the blended teaching mode is the specific application of Gardner and Tomlinson ‘s theory. By carrying out the online and offline differentiated teaching reform, applying and practicing these theory, the reform results of this study can be extended to other language or other professional teaching, the theory can also be popularized and applied.

REFERENCES

[1] Deng Xinghua;Mo Shanyun(2018).The Reform of Differentiated English Teaching in Colleges and Universities from the Perspective of Cultivating Applied Talents.Journal of Hezhou

University,34(04):153-155.

[2] Ji Qingfen,(2017).Differentiated Teaching Design of Higher Vocational English Based on Multiple Intelligences Theory.Journal of Wuxi Vocational and Technical College,16(01),32-34.

[3] Howard Gardner,(1990). The Structure of the Mind. Translated by Lan Jinren. Beijing: Guangming Daily Press, 35-35.

[4] Tomlinson, C,(1999). The Differentiated Classroom: Responding to the Needs of All Learners. Alexandria, VA:ASCD.

[5] Hu T.(2021). Research on International Blended Foreign Language Teaching: Review and Prospect [J]. Journal of Guizhou Normal University, 37(07),74-84.

[6] Parley Cougar Hall , Christopher B. Curtis, Joshua H. West (2019), Individual Book Reports: An Application of Differentiated Instruction in Two Public Health College Courses.Health, 11, 1247-1256.

[7] Solomon Melese, Cogent Education (2019) Instructors' knowledge, attitude and practice of differentiated instruction: The case of college of education and behavioral sciences, Bahir Dar University, Amhara region, Ethiopia, 6: 1642294