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The Smart Class Teaching Module for Rehabilitation Medicine English Education in China

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Background: Learning medical English is particularly challenging for non-native English-speaking medical students. The Smart Class teaching module is a new online teaching module for rehabilitation-related medical English, the efficacy of which has yet to be established in the literature. Gender differences should also not be ignored in our study, taking into account the proven performance differences between males and females in language learning.

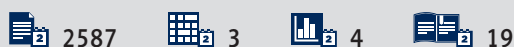
Material/Methods: First-year physiotherapy students in Grade 2018 and Grade 2019 at Guangzhou Medical University were recruited to participate in this study. Grade 2019, as the experimental group, completed the Smart Class teaching module, while Grade 2018, as the control group, completed the Traditional Class teaching module. The efficacy of both modules was assessed objectively using the students' medical English exam scores and subjectively using the students' responses to a questionnaire.

Results: In total, 242 questionnaires were distributed, and 210 valid questionnaires were returned, of which 119 were from the Smart Class teaching module group and 91 were from the Traditional Class teaching module group. There was no statistically significant difference between the medical English exam scores of the 2 groups ($P=0.324$). However, the subjective assessment revealed that the students experienced a significantly greater burden from the workload in the Smart Class teaching module group ($P<0.001$).

Conclusions: We found both the Smart Class teaching module and the Traditional Class teaching module achieved similar teaching outcomes. Therefore, the former represents a viable alternative teaching option for situations where traditional class teaching is not possible.

MeSH Keywords: Education, Medical, Undergraduate • Rehabilitation • Teaching

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Background

Medical English is one of the important basic medical professional courses and includes the specialized vocabulary used by healthcare professionals and clinical researchers. Learning medical English is conducive to international professional communication, literature comprehension, and scientific research [1]. However, for non-native English medical students, learning medical English is particularly difficult because it necessitates acquiring both language and medical knowledge [2]. Moreover, different medical sub-specialties have different medical English learning priorities. College-level education in rehabilitation and physical therapy started late in China and needs to be better aligned with international standards [3]; as such, it lacks the experience and professionalism of other medical fields. Additional challenges facing teaching practice include increased content, frequent updates, and challenging self-study assignments.

The Smart Class teaching module (also known as blended learning) is a new teaching module that mixes traditional class teaching modules and network-based autonomous learning, which relies on modern information technology and network media to build a teaching platform covering teaching resources, real-time classrooms, and interactive communication. It helps teachers foster an effective educational environment for students [4,5]. In medical English education for rehabilitation medicine college students, the traditional class teaching module mostly utilizes a passive study method (only relying on learning from the teacher's in-class teaching) and ignores the cultivation of students' autonomous learning. Therefore, we employed the Smart Class teaching module to teach medical English at the college level with the aim of identifying any differences in teaching outcomes between the Smart Class teaching module and the Traditional Class teaching module, as well as to aid in the reform of medical English teaching in China. In addition, since gender differences in language learning performance have been found and replicated in numerous studies [6–8], we also investigated the impact of gender differences on medical English learning in our study.

Material and Methods

Subjects

The Grade 2018 and Grade 2019 physiotherapy students at the Physical Therapy and Rehabilitation College of Guangzhou Medical University were recruited to participate in this study. Our study was approved by the Ethics Association of the Fifth Affiliated Hospital of Guangzhou Medical University and was performed in accordance with their ethics standards. Inclusion criteria were: (i) age 17–22 years old, (ii) completed the medical

English course in their first year, (iii) a first-year undergraduate student of physiotherapy, and (iv) willing and able to participate in the study. The questionnaire was distributed by cell phone as an online survey to the physiotherapy students during the first week after final exams. The questionnaires were distributed to 242 students in total.

Interventions

Two teaching modules were used in this study at the first academic year. Grade 2019 (the experimental group) completed the Smart Class teaching module for medical English study, whereas Grade 2018 (the control group) completed the Traditional Class teaching module for medical English study. The same textbook, syllabus, classes (18 hours of theoretical coursework), and teacher team were used for the 2 medical English teaching modules. Then, the students from both groups completed the medical English exam (final exam with a full score of 100) which included 20 single-answer questions and 5 multiple-answer questions, 6 translation questions, and 3 case-analysis questions. It was used primarily to evaluate the students' mastery of professional terminology, their English reading ability of professional references, and their ability to analyze clinical cases in professional medical English.

Student questionnaire

All of the students taking the 2 teaching modules (Smart Class teaching module and Traditional Class teaching module) were asked to voluntarily complete the same anonymous, online questionnaire 1 week after the medical English course finished (student questionnaire seen in the **Supplementary 1** for details). This student questionnaire included a student's basic information (grade, age, gender, college entrance examination scores, characteristics of learning English, objectives for learning English, time spent learning English each week) and 14 multiple-choice questions about their medical English course, which could be grouped into 5 main topics: 1) Course attractiveness (Question 8, Question 9, and Question 10); 2) Course teaching effectiveness (Question 11, Question 12, Question 13, and Question 14); 3) Course workload (Question 15 and Question 16); 4) Curriculum resources (Question 17 and Question 18); 5) Curriculum improvement (Question 19, Question 20, and Question 21). The respondents provided their answers to each of the 14 questions using 5-point Likert-type scales.

We used Sample Size Calculator (the public service of Creative Research Systems survey software: <https://www.surveysystem.com/sscalc.htm#one>) to determine how many valid questionnaires we required in order to get results that reflect the target populations as precisely as needed. We set a confidence level of 95% and a confidence interval of 5, and found a required minimum sample size of 152.

Table 1. Basic characteristics.

Variable	Traditional Class teaching module	Smart Class teaching module	P-value
Grade	Grade 2018	Grade 2019	NA
Student number	120	122	NA
Questionnaires distributed	120	122	NA
Valid questionnaires returned	91	119	NA
Age (years)	19.11±0.83	19.06±0.76	0.687
Gender (Male/Female)	31/60	48/71	0.353
English entrance exam score (points)	119.51±11.57	117.92±13.20	0.374
Male	115.15±12.42	111.86±14.24	0.334
Female	121.99±10.59	121.97±10.48	0.992
P-value	0.013	<0.001	

Values are presented as a number or mean±standard deviation. Statistical significance was set as $P<0.05$ and marked in bold.

External reliability was assessed by Spearman's correlation coefficients. The value should be more than 0.60, which represents a strong correlation, indicating good external reliability of the questionnaire [9]. Internal reliability was assessed by Cronbach's alpha coefficient. Cronbach's alpha score was found to be more than 0.70, which indicates an acceptable level of questionnaire reliability [10]. Moreover, the questionnaire validity was assessed by Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's sphericity test. KMO value should be more than 0.60 and the statistically significant value should be less than 0.001 ($P<0.001$), which indicate that the sampling was sufficient and data had normal distribution [11].

Statistical analysis

Statistical analysis was carried out using IBM SPSS 25.0 software. Normally distributed data are represented using the mean±standard deviation, data that do not conform to the normal distribution are represented using the median, and count data are represented by constituent ratio or rate. The measurement data from the 2 groups (Smart Class teaching module vs. Traditional Class teaching module; male vs. female) that conform to normal distribution and the homogeneity of variance were compared using an independent samples *t* test. Measurement data from the 2 groups that do not conform to the normal distribution and the uniformity of variance were compared using the nonparametric rank-sum Mann-Whitney U test. The 5 answers to the 14 multiple-choice questions on the student questionnaire were assigned values of 1 to 5 according to responses A to E, with lower values indicating a worse or more negative situation versus the higher values indicating a better or more positive situation. The average score was calculated within the 5 thematic categories, and then the 2 groups were statistically analyzed. The test level was statistically significant at $P<0.05$.

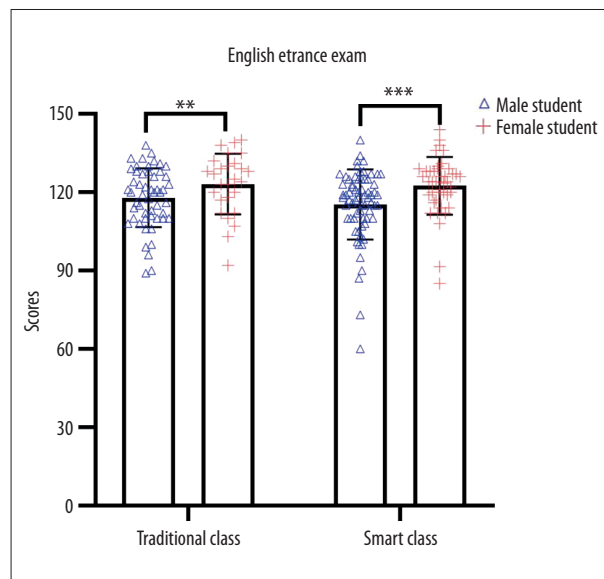


Figure 1. The English entrance exam of Smart Class teaching module and Traditional Class teaching module.

Results

Baseline

In our study, 242 questionnaires were distributed, and 210 valid questionnaires were returned (age, 19.08±0.79 years old; 79 male students and 131 female students). Of these, 119 valid questionnaires were collected from the Smart Class teaching module group (age, 19.06±0.76 years old; 48 male students and 71 female students) and 91 valid questionnaires were collected from the Traditional Class teaching module group (age, 19.11±0.83 years old; 31 male students and 60 female students). The English entrance exam scores for the different teaching modules were 119.51±11.57 for the Smart Class

Table 2. The differences in medical English exam scores between the 2 types of teaching modules and by sex.

Variable	Traditional Class teaching module	Smart Class teaching module	P-value
Medical English exam scores	78.91±10.32	80.26±10.83	0.324
Male	73.82±13.49	77.03±13.00	0.246
Female	81.93±6.20	82.49±8.44	0.647
P-value	<0.001	0.006	

Values are presented as a number or mean (±standard deviation). Statistical significance was set as $P < 0.05$ and marked in bold.

teaching module group and 117.92 ± 13.20 for the Traditional Class teaching module group.

No statistically significant differences were found in age, gender ratio, gender distinction, or total English entrance exam scores. However, the English entrance exam scores of the male students were lower than those of the female students in both teaching module groups (Smart Class teaching group: male 111.86 ± 14.24 , female 119.51 ± 11.57 , $P = 0.013$; Traditional Class teaching group: male 115.15 ± 12.42 , female 111.86 ± 14.24 , $P < 0.001$) (Table 1, Figure 1).

Medical English exam (final exam)

No statistically significant difference in medical English exam scores was found between the Smart Class and Traditional Class teaching modules. However, female students scored higher than male students in both teaching module groups (Smart Class teaching module: male 73.82 ± 13.49 scores, female 81.93 ± 6.20 , $P < 0.001$; Traditional Class teaching module: male 77.03 ± 13.00 scores, female 82.49 ± 8.44 , $P = 0.006$) (Table 2, Figure 2).

Student questionnaire

We performed reliability (external and internal reliability) and validity tests for the student questionnaire. Eleven students from Grade 2019 were randomly selected to fill in the questionnaire twice with a 2-week interval. The external reliability coefficient of the questionnaire was 0.814, indicative of good external reliability. The alpha coefficient was 0.762, which indicated good internal reliability. The KMO value was 0.832, which indicated that the validity of the questionnaire was good.

There were no statistically significant differences in course attractiveness, teaching effect, course resources, or course improvement between the 2 teaching modules by gender, except for academic load. The Smart Class teaching module group reported a greater academic load than the Traditional Class teaching module group (Smart Class teaching module: 2.64 ± 0.54 , Traditional Class teaching module: 3.02 ± 0.65 ; $P < 0.001$). Moreover, the responses to Question 15 (the extra

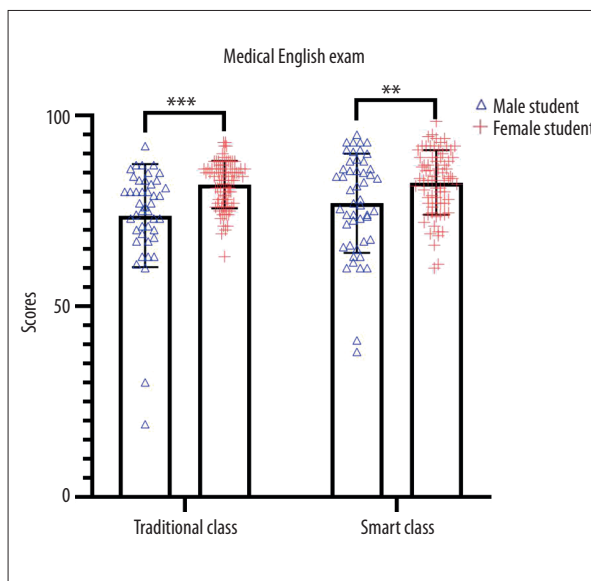


Figure 2. The Medical English exam of Smart Class teaching module and Traditional Class teaching module.

burden from medical English study) and Question 16 (the difficulty of preview and review of medical English) were significantly different between the 2 groups, indicating that the students in the Smart Class teaching module experienced significantly greater academic load than those in the Traditional Class teaching module (Question 15: Smart Class teaching module 2.82 ± 0.83 , Traditional Class teaching module 3.35 ± 0.86 , $P < 0.001$; Question 16: Smart Class teaching module 2.50 ± 0.78 , Traditional Class teaching module 2.84 ± 0.82 , $P = 0.003$) (Table 3). In addition, there were no significant differences in the perception of both teaching module methodologies between male and female students (Figure 3). Figure 4 shows that the largest percentage of learning type (Question 5) in both teaching modules was reading type. The 2 largest percentages of objectives of learning medical English (Question 6) in both teaching modules were passing the exam and application of medical English. The largest percentage of extra time off-class learning (Question 7) in both teaching modules was 0 hours. The majority of students in both teaching modules thought it was necessary to increase practice of medical English (Question 21).

Table 3. Questionnaire results according to teaching module and by gender.

Questionnaire Item	Teaching module			Gender		
	Traditional Class teaching module	Smart Class teaching module	P-value	Male	Female	P-value
I Course attractive	3.38±0.64	3.71±0.70	0.418	3.35±0.65	3.33±0.69	0.827
II Teaching effect	3.15±0.59	3.08±0.71	0.457	3.10±0.62	3.12±0.68	0.846
III Academic load	3.02±0.65	2.64±0.54	<0.001	2.72±0.60	2.86±0.63	0.095
Question 15	3.35±0.86	2.82±0.83	<0.001	2.91±0.85	3.13±0.90	0.337
Question 16	2.84±0.82	2.50±0.78	0.003	2.62±0.81	2.66±0.82	0.942
IV Course resources	3.17±0.70	3.10±0.76	0.772	3.06±0.77	3.14±0.71	0.480
V Course improvement	3.55±0.70	3.55±0.62	0.955	3.47±0.60	3.60±0.68	0.149

Values are presented as a number or mean (±standard deviation). Statistical significance was set as $P < 0.05$ and marked in bold. Question 15, “Do you think the Medical English course you enrolled in caused you any extra burden?”; Question 16, “Do you find it difficult to review before or after the Medical English course class period?”.

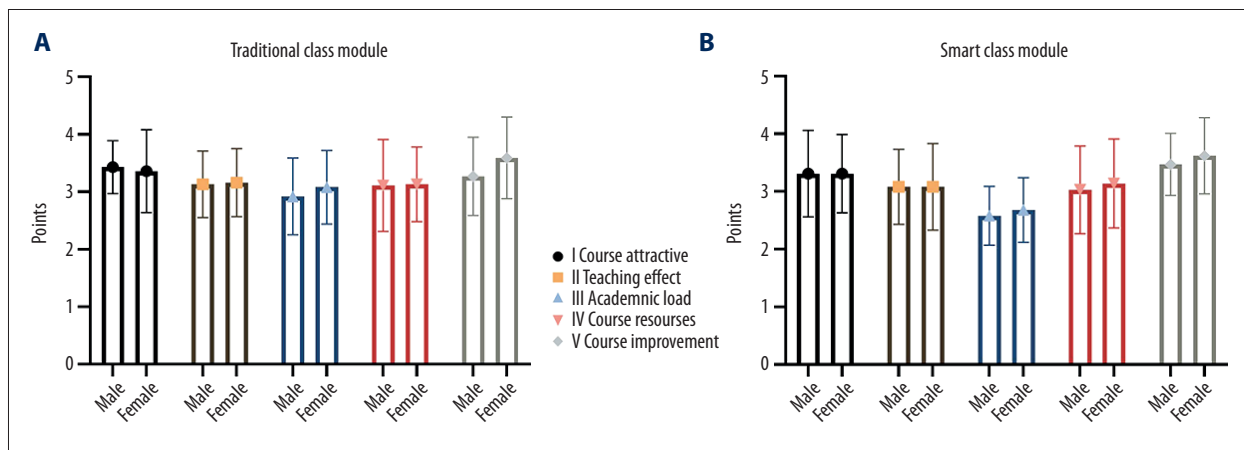


Figure 3. (A, B) Questionnaire results between male and female students in each of the teaching modules.

There were 24 students in the Smart Class teaching module group and 13 students in the Traditional Class module group who gave an answer to Question 22. In the Smart Class teaching module group, 29.2% of students indicated that they need more self-discipline in learning for preview, versus 8% of students in the Traditional Class teaching module group. Other suggestions involved adding practice class hours and increasing more learning materials specific to rehabilitation medicine.

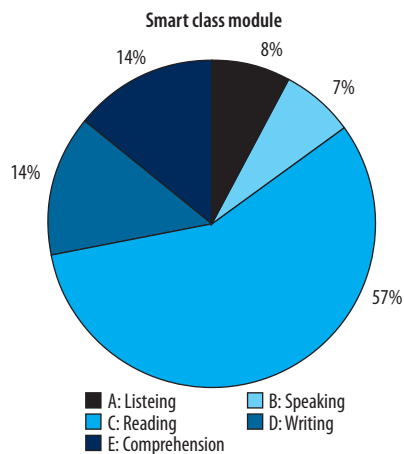
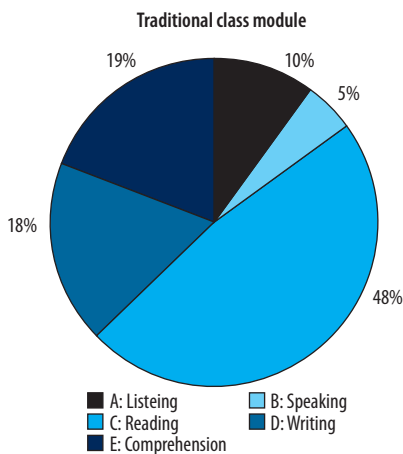
Discussion

Medical English is a particularly difficult aspect of medical professional teaching, especially for medical students for whom English is not their first language. Our study employed objective evaluation methodology (student exam scores) and subjective evaluation methodology (student survey data) to explore the application of the Smart Class teaching module in medical

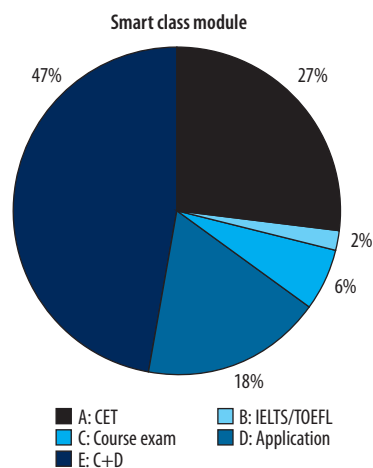
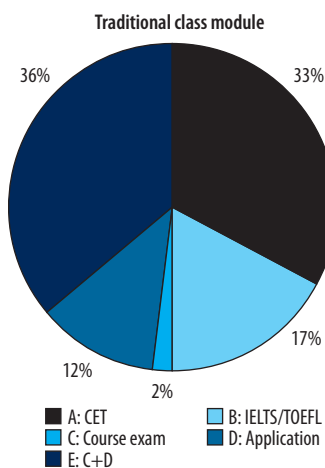
English among rehabilitation medicine students in China. The results showed that the Smart Class teaching module achieved similar teaching effects in medical English compared with the Traditional Class teaching module. To the best of our knowledge, there is no previous research published on this topic.

The Smart Class teaching module employed by this study was a blended teaching module built through the Chaoxin Online Teaching Information Platform (<http://i.mooc.chaoxing.com> and <http://gzhmu.fanya.chaoxing.com/portal>), in which instructors could teach remotely and students could engage in flexible independent learning; for example, the student could perform “pre-class preview”, “interactive teaching in class”, and “review after class” under the Smart Class teaching module. Teachers could also obtain student feedback through the data platform, which could be used to accurately analyze the students’ progress, customize personalized learning plans, and adapt to individual differences. To the best of our knowledge,

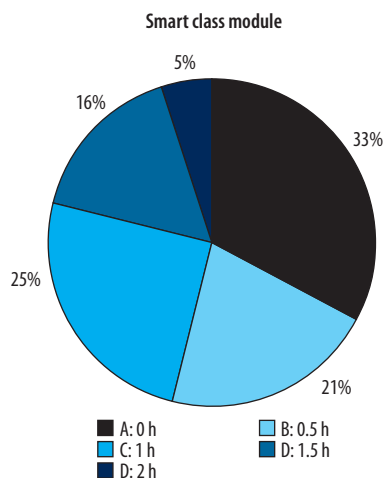
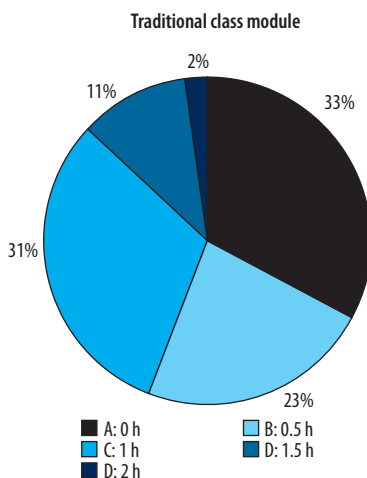
Question 5:
Learning type



Question 6:
Objectiv of
learning
medical english



Question 7:
Extra time off-
class learning



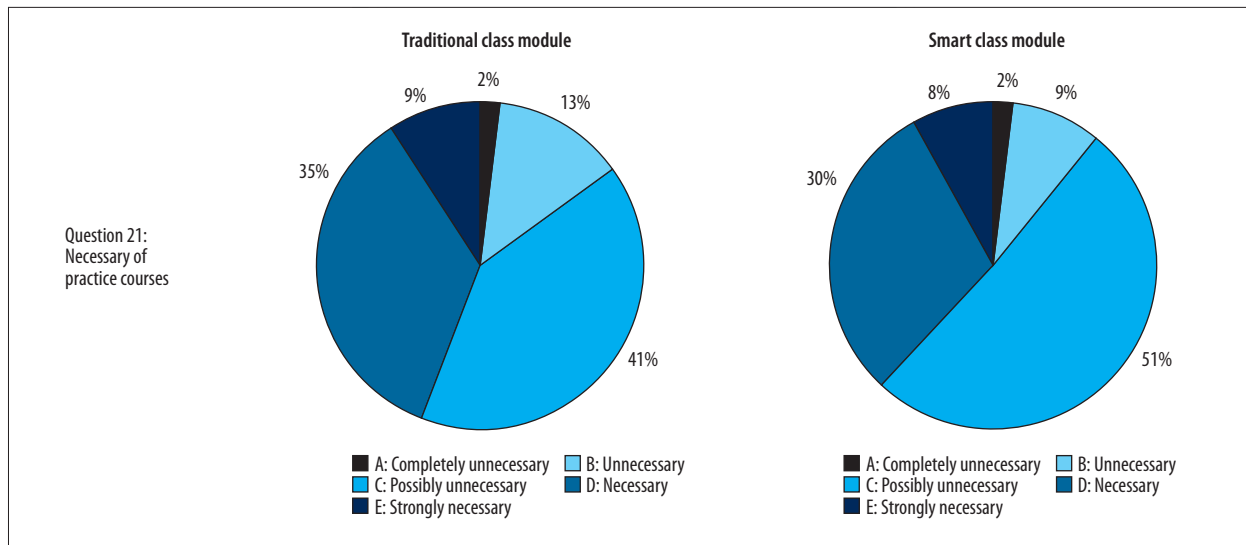


Figure 4. The distribution of Questions 5, 6, 7, and 21 in the Smart Class teaching module and Traditional Class teaching module.

there are no studies specifically on the Smart Class teaching module for medical-related learning. The Smart Class teaching module is not exactly equivalent to the online teaching module, but they have much in common. A systematic review suggested that the online teaching module improved medical-related teaching [12]. However, other studies showed that online classes achieved similar effects in knowledge acquisition as traditional classes in subjects such as otolaryngology (head-and-neck surgery) [13], medical ethics [14], and end of life care [15]. Our study produced several interesting results. First, there was no statistically significant difference between the medical English exam scores under the Smart Class teaching module and the Traditional Class teaching module, indicating that the objective teaching effects were the same. Therefore, when the Traditional Class teaching module cannot be implemented (e.g., due to geographic restrictions or pandemics), the Smart Class teaching module is an effective and feasible way to sustain educational progress. Meanwhile, it should be noted that the Smart Class teaching module as an innovative methodology did not show advantages over the Traditional Class module in medical English study. Although students under the Smart Class teaching module have the more chance to access the learning materials for preview, as other studies found [16,17], it might be challenging in prereview learning of medical English by themselves. However, the results of the subjective student questionnaire on medical English under the 2 teaching modules showed students felt a greater learning load in the Smart Class teaching module group than in the Traditional Class teaching module group. We identified 2 potential reasons for this. On the one hand, the Smart Class teaching module required higher self-discipline in learning for prereview (see results of Question 22). On the other hand, although the teaching time did not increase compared with the Traditional Class Teaching module (see results of Question 7),

the subjective burden of students in the Smart Class teaching module group was heavier (see results of Question 15). This might be related to the public health emergencies that occurred when the Smart Class teaching module was being implemented. Several courses adopted the Smart Class teaching module at the same time, all of which required prereview and produced a superimposed burden effect.

Moreover, the students provided some great suggestions for the medical English course setting at the end of the student questionnaire. For example, students wrote that the content of the medical English course was difficult to learn, the start of study time was too early (the first year of medical college), and the total class hours were short (18 class hours). Furthermore, they suggested adding an application class (the results from Questions 21 and Figure 4) to improve their comprehensive listening, speaking, reading, and writing abilities. All of these suggestions can help optimize the teaching of medical English in China.

Furthermore, gender differences in language learning performance have been found and replicated in numerous studies [6,7,18], so we also investigated the impact of gender differences on medical English learning. We found the advantages of females in language learning, such as better English entrance exam scores and final medical English exam scores in females than in males, whereas no significant gender differences found in subjective student questionnaires, which might be related to English level at the time of admission being the key factor influencing the final English exam scores, and the slight advantages in early development of the language cortex in brains of females than in males [19]. Future studies may further explore gender as a factor in individualized reform of language teaching.

Limitations

Students' English entrance scores could not be correlated to their medical English exam scores due to the assurance of anonymity, which ensured the objectivity of the survey. Therefore, the student questionnaire does not take into account the impact of English entrance scores on the medical English exam scores.

Supplementary Data

Supplementary 1. Student questionnaire for medical English study

Informed Consent for the Subject

Dear student/subject for Medical English study,

Greetings!

This is a student questionnaire for Medical English study in Guangzhou Medical University, which is used in order to understand the study situation and to help guide further teaching practice.

Our study was approved by the Ethics Association of the Fifth Affiliated Hospital of Guangzhou Medical University and is in accordance with its ethical standards. If you have any other questions, please contact the research executive Haining Ou (Tel. 86 1591 8673 453).

Research content and explanation

This Student Questionnaire includes a student's basic information (grade, age, sex, college entrance examination scores, characteristics of learning English, objectives for learning English, time spent learning English each week) as well as 14 multiple-choice questions about your Medical English course.

Conclusions

This study compared the outcomes of the Smart Class teaching module and the Traditional Class teaching module in the Medical English course practice among rehabilitation therapy students. We found both teaching modules achieved a similar teaching effect. The Smart Class teaching module may be an alternative teaching method for situations where the Traditional Class teaching module is not possible, such as geographical restrictions and public health emergencies. Overall, the findings of the present study indicate that the medical English curriculum still requires further optimization.

The whole questionnaire will take you about 10 minutes to complete.

Please understand that your careful and truthful answers are essential to scientific conclusions. You do not have to guess the design of the study or the intention of the question, and there is no right or wrong answer.

Confidentiality principle

Confidentiality does not collect of this study is to identify your personal identity of sensitive information and there is no sensitive issues involved. All data in this study will be used for scientific purposes only.

Participants benefit

Since this research is used for teaching reform and there is no economic benefit for anyone, no corresponding compensation is provided

Because of confidentiality, do NOT put your signature on the questionnaire. If you continue on the next page, that means you have read the above and volunteered to participate in this study. Thank you for your patience and reply.

Student Questionnaire for Medical English Study

Question 1: Which Grade are you in? ()

- A. Grade 2018 B. Grade 2019

Question 2: How old are you? ()

Question 3: Sex:

- A. Male B. Female

Question 4: What was your English entrance exam scores? ()

Question 5: What's your type for English learning?

- A. Listening type
B. Speaking type
C. Reading type
D. Writing type
E. Comprehensive type

Question 6: In addition to learning professional knowledge, what else do you hope to gain from learning medical English?

- A. Pass CET
B. Pass IELTS/TOEFL
C. Pass Course exam
D. Application
E. C+D

Question 7: Apart from the time spent in medical English class, how long did you spend studying medical English per week?

- A. 0 h
B. 0.5 h
C. 1 h
D. 1.5 h
E. 2 h

Question 8: Do you like the medical English course you took?

- A. Completely do not like
B. Do not like
C. Possibly like
D. Like
E. Like very much

Question 9: Do you think the medical English course was interesting?

- A. Very boring

- B. Boring
C. Might be interesting
D. Interesting
E. Very interesting

Question 10: Do you find medical English attractive?

- A. Totally unattractive
B. Unattractive
C. Might be attractive
D. Attractive
E. Very attractive

Question 11: Do you think the medical English course you completed was effective?

- A. Very bad
B. Bad
C. Possibly good
D. Good
E. Very good

Question 12: Do you think the medical English course improved your independent learning ability?

- A. Not improved at all
B. Not improved
C. Might be improved
D. Improved
E. Exceedingly big improvement

Question 13: Do you feel that you have a high degree of self-discipline when studying the medical English course?

- A. Completely self-disciplined
B. Not self-disciplined
C. Possibly self-disciplined
D. Self-disciplined
E. Very self-disciplined

Question 14: Do you benefit from learning medical English for your Rehabilitation study?

- A. Not helpful
B. Possibly helpful
C. A little helpful
D. Helpful
E. Very helpful

Question 15: Do you think the medical English course you enrolled in caused you any extra burden?

- A. Caused a very heavy burden
- B. Caused a certain burden
- C. Might cause some burden
- D. Caused no burden
- E. Very easy, no burden at all

Question 16: Do you find it difficult to review before or after the medical English course class period?

- A. Very difficult
- B. Difficulties
- C. May have difficulty
- D. No difficulty
- E. No difficulty at all

Question 17: Did you use a variety of resources such as videos and case studies in your medical English course study? Did these resources help your study?

- A. Not at all
- B. No
- C. Resources available, not helpful
- D. Some helpful resources
- E. A lot of resources, great help

Question 18: Does it affect your study to not have medical English materials specific to Rehabilitation Medicine?

- A. Affected a lot
- B. Affected
- C. Possibly affected
- D. Not affected
- E. Not affected at all

Question 19: Do you think it is necessary to study medical English in addition to public English?

- A. Very unnecessary
- B. Unnecessary
- C. May be necessary
- D. Necessary
- E. Very necessary

Question 20: If you continue to study the advanced 16 hours of professional English courses in the fifth semester, and learn how to apply medical English in professional reference reading and scientific paper writing, would you want to continue studying?

- A. I do not want to continue learning medical English at all
- B. I do not want to continue learning medical English
- C. I might want to continue learning medical English
- D. I want to continue learning medical English
- E. I really want to continue learning medical English

Question 21: Do you think it is necessary to add practice classes to the medical English course?

- A. Completely unnecessary
- B. Unnecessary
- C. Possibly unnecessary
- D. Necessary
- E. Highly necessary

Question 22: Do you have any other suggestions for professional English courses? (Open-ended question)

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