

Discussion and Practice of Blended Teaching in Basic Theory and Application of GSM-R

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Abstract: In order to accommodate the trend of high-speed railway signaling integrating with communication techniques, *Basic Theory and Application of GSM-R* is a crucial curriculum for students majoring in *Traffic Information Engineering and Control* and *Transportation Engineering*. It helps students to master the latest theory and application of train-ground communication techniques. However, with the application of the next generation railway mobile communication technique, several advanced communication techniques are presented in the form of English materials. It is of great significance to have a bilingual teaching mode for this course. This would contribute to cultivating research-oriented and professional talents with international competitiveness. Through the blended teaching reform of bilingual education, the proportion of topic selection of interdisciplinary research papers by postgraduates has increased from 6% to 15%. In this article, the characteristics and the current problems of bilingual teaching are discussed from theory to practice in three aspects: the production of bilingual courseware, the supplement of English materials, and the guidance of research topics. Additionally, corresponding teaching reform schemes are proposed in this article.

Keywords: GSM-R; Blended teaching; Bilingual education; Teaching reform; Cross-disciplinary

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1. Introduction

After China became a member of the Washington Agreement in June 2016, the mutual recognition of international engineering degrees has become the strongest driving force for postgraduate students to improve their skills in English communication and foreign literature reading as well as keep abreast of the latest development in their field. GSM-R (Global System for Mobile Communications-Railway) is a comprehensive and dedicated digital mobile communication system designed specifically for railway communication based on the GSM Phase 2+ specification protocol. It is applicable to the needs of railway applications, and its standard basis is the GSM specification protocol. With the development of communication technology, International Union of Railways has also released the requirement specification for the next generation of railway mobile communication technology. In order to accommodate the trend of high-speed railway signaling integrating with communication techniques, *Basic Theory and Application of GSM-R* is a crucial curriculum for students majoring in *Traffic Information Engineering and Control* and *Transportation Engineering*. It helps students to master the latest theory and application of train-ground communication technique. However, with the application of the next generation railway mobile communication technique, several advanced communication techniques are presented in the form of English materials. Hence, it is urgent to reform the teaching of this course and implement the

bilingual teaching mode. The implementation of bilingual teaching, an important measure to promote the reform of higher education, is necessary to cultivate new composite talents in the 21st century and also high-quality talents with international vision under the strategy of “strong transportation country, railway first” and “one belt and one road” [1]. The role of the course should not be underestimated.

Considering the professional knowledge structure of students in rail transit signaling, the lectures for undergraduates are mainly about GSM-R system structure, system function, and the combination with train operation control. *Basic Theory and Application of GSM-R* is offered to graduate students; in addition, the construction and teaching reform of bilingual teaching has been explored and implemented. Since there are many issues involved in bilingual teaching, it is necessary to explore the theory and practice of it.

2. Theoretical discussion on the implementation of bilingual education

Bilingualism is a method adopted by a number of immigrant countries or multicultural countries in North America in the 1960s to enable immigrants or refugees to integrate with the locals in a faster pace (solving problems such as language barriers in employment and education) by using two languages. In China, bilingual education originally referred to schools in minority areas that enabled minority students to learn Chinese, the dominant language in China, while retaining their minority language. So, what is bilingual education? It is the use of a second or foreign language in school for the teaching of content subjects [2], as defined in the Longman Dictionary of Applied Linguistics, published by the famous Longman Publishing House in the United Kingdom (UK). At present, bilingual teaching, which is promoted in China, mainly refers to the teaching of other non-language subjects using English. It is mainly in English and Chinese, and the purpose of bilingual teaching is to improve students' English application skills by exposing them to more languages.

First of all, bilingual teaching is a new requirement of social development for modern higher education, and it is a necessary way to cultivate international talents as well as talents in China. First of all, based on realistic needs, the teaching of bilingual courses would encourage students to read relevant English literatures consciously; in addition, students would be able to use relevant English programming tools skillfully to study with the characteristics of engineering majors as well as handle and communicate the information of this professional course in a way that conforms to international practice.

Secondly, mindset development is the key to conducting bilingual education. The goal is for students to learn to think and solve problems in both their native language and English as well as to be able to exchange freely between the two languages. English learning is difficult, and the main reasons for this are reflected in cognitive differences, cultural differences, and language differences. The thinking habit of Chinese people is usually from shallow to deep, and finally to the key point, which is the “finishing touch.” Foreigners, especially Americans, generally have a more direct way of thinking. This difference in the cognitive process requires constant feeling, experience, and accumulation of sufficient knowledge in English to describe and elaborate on various events, in order to be comfortable with it. The differences between Chinese and English languages due to different thinking habits and cultural backgrounds are far from enough to focus on superficial understanding; it is more important to develop a sense of the language and achieve familiarity. Therefore, it is necessary to create more opportunities for students to speak English inside and outside the classroom, so that they can be more proficient in using the language.

Finally, the issue of students' acceptance is an important index for the evaluation of the effect of bilingual teaching. The achievement of this index requires the interaction among teachers, students, and the school. Firstly, schools should consider promoting bilingual teaching from the beginning of the curriculum, arrange the teaching system of bilingual professional courses before and after bilingual teaching, and set

the system in such a way that the teaching of professional-related courses reach the primary stage of bilingualism, while professional core courses reach the advanced stage, so as to promote the bilingual teaching of professional courses in a scientific and systematic way. Secondly, the teachers involved in bilingual teaching should constantly look for new teaching methods to enhance the liveliness of the classroom^[4], attract students' attention through various means, such as multimedia teaching and case teaching, as well as improve the effect of bilingual teaching in regard to students' acceptance.

3. Measures and effects of implementing bilingual education

As the transmission carrier of train operation control information, GSM-R is one of the key systems to ensure the safety of train operation. It is also the technical support and guarantee for the rapid development of high-speed railway in China. It is in this context that *GSM-R Technology and Application*, as one of the compulsory courses of the national specialty – *Rail Transit Signal and Control*, was started. However, due to the diversity of graduate students and the differences in the curricula of respective universities, many graduate students majoring in *Traffic Information Engineering* as well as *Control and Transportation Engineering* have not learned about GSM-R in their undergraduate years. Therefore, in the implementation of the bilingual teaching reform in *Basic Theory and Application of GSM-R*, targeted measures should be taken to balance learning efficiency and equity.

3.1. Measures for implementing bilingual education

3.1.1. The “three-steps” strategy

(1) Using the “three-steps” strategy

The basic idea and method of the bilingual teaching reform of *Basic Theory and Application of GSM-R* is to first assess the students' English level and professional knowledge. The bilingual teaching reform can then be carried out based on the assessment results and combining existing textbooks, English specifications, as well as the latest scientific and technical papers in the field^[5].

(2) Implementing the “three-steps” strategy

Step 1: In the first 2-3 lectures of the course, the main contents are systematically introduced in the native language using the selected Chinese textbooks, and the basics of communication and key technologies involved in GSM-R wireless communication are explained on demand.

Step 2: English reference materials (GSM-R specifications, latest research results of LTE-R, as well as scientific and technical papers on railway-specific wireless communication systems) are mainly used, allowing students to learn from Chinese textbooks as an auxiliary way to further explain the main contents of the course.

Step 3: English is used as much as possible to conduct exploratory lectures for the FRMCS technology (Future Railway Mobile Communication System).

(3) Evaluation and improvement of the teaching effect

The bilingual teaching reform of *Basic Theory and Application of GSM-R* was planned to be implemented for two years for graduate students of 2017 and 2018. After the implementation in 2017, the reform was evaluated to assess whether the teaching methods were appropriate, whether the classroom atmosphere meets the requirements of bilingual teaching, provide improvement strategies, as well as improve students' mastery in professional knowledge and their foreign language proficiency. Then, the improved plan was implemented for graduate students in 2018, and the process from student evaluation, teaching implementation, to teaching effect evaluation was repeated^[6].

3.1.2. Enriching bilingual teaching materials

In regard to GSM Phase 2+ English protocol specification related content materials, from the railway application-oriented level, add and organize FA (Functional Addressing), LDA (Location-dependent Addressing), etc. The course should be a good reference for basic theoretical knowledge in both English and Chinese, in order to fully supplement the academic research frontiers of the course related knowledge and to exercise students' ability in succeeding the next generation mobile communication technology.

Prepare one set of supplementary lecture notes for the course, mainly in reference to *Dedicated Wireless Communication for High-Speed Railway*, and supplement with other English materials: GSM Phase 2+ specifications, new LTE-R technology, as well as Future Railway Mobile Communication System (V2.0, V3.0, and V5.0) related specifications.

Produce one set of bilingual teaching materials pertaining to the innovation and development of GSM-R in China, introduction of communication in high-speed railway, principle of GSM-R system structure, function of GSM-R, and application of GSM-R system in Wuhan-Guangzhou high-speed railway.

3.1.3. Exploratory discussion on selected topics

The joint research of User Requirement Specifications (URS) of FRMCS with graduate students exercises the ability of students to follow the next generation of mobile communication technology. Meanwhile, in the process of implementing bilingual teaching, the focus is on the ability of students to improve their mastery of English materials on the basis of understanding the course contents, expanding students' professional knowledge and interdisciplinary aspects, as well as actively guiding students to choose topics for graduate studies in interdisciplinary fields.

3.2. Effects of implementing bilingual teaching

The results of bilingual teaching in *Basic Theory and Application of GSM-R* are remarkable and have played an exemplary role for other professional courses. Students have invested great enthusiasm in learning the course, and while learning professional knowledge, they have also improved their English application skills and cultivated the ability to think and solve professional problems in English. Meanwhile, teachers have absorbed advanced teaching concepts and methods as well as achieved fruitful results in the construction of bilingual teaching materials and in guiding students with their topic selection.

The most basic gain of bilingual teaching is the updating and mastering of subject knowledge and ability, the most direct gain is the improvement of English vocabulary and English proficiency, and the deepest gain is the introduction of foreign advanced teaching concepts and teaching methods. With the implementation of bilingual teaching, new teaching ideas contained in the original textbooks related to the majors further broaden their teaching ideas and promote their integration of professional knowledge.

With English lecture notes and bilingual courseware, students would not only acquire professional knowledge and improve their language skills, but also learn and comprehend the logical way of thinking implied in the original text as well as familiarize with the language norms of international professional communication. The outstanding feature of English lecture notes is their practicality, which can also improve students' ability to analyze and solve problems, thus applying what they have learned to their practical work. In addition, bilingual teaching enables students to achieve the goal of improving their English proficiency through their experience of the language of instruction; in addition, their ability to apply English would be strengthened consciously and unconsciously as they try to digest what the teacher has taught in class.

In order to test the effect of the bilingual teaching reform, a statistical analysis of the number of students taking the course and the opening topics in the past three years has been carried out. The statistical results

are shown in **Table 1**.

Table 1. Statistical results of the course selection

Grade	Number of topic selection	Total number of students	Number of students choosing in the direction of communication	Percentage
2016	4	32	2	0.06
2017	21	46	7	0.15
2018	18	42	5	0.12
2019	35	53	8	0.15
2020	38	66		

A number of students who wish to pursue a higher degree in the future showed high enthusiasm for learning and a positive attitude toward bilingual teaching, considering it to be keeping up with the times. They have also suggested the continuation of using English lecture notes while expecting the assembly of teaching materials. Meanwhile, many students showed strong research interest in cross-disciplinary topics. By analyzing the topics chosen by graduate students majoring in *Transportation Engineering* in 2017, 2018, and 2019, it can be seen that the proportion of students who chose in the direction of communication reached 15.2%, 11.9%, and 5.1%, respectively; the topics mainly focus on radio wave propagation of the railway integrated digital mobile communication system, switching mechanism at crossing areas, vehicle-vehicle communication resource management, vehicle-vehicle communication technology (antenna, channel model, and application of column control technology), as well as LTE-R/M related technology research. From the statistical results of the topic selection in the opening report of graduate students, it can be seen that the bilingual teaching reform and the constant updates of foreign language materials have effectively enhanced the diversity of students' topic selection and the extension of their professional knowledge, thus basically achieving the goal of the course reform.

4. Shortcomings of the current bilingual teaching reform

4.1. Problems with the students

Bilingual teaching does not only place extremely high demands on teachers, but also require students to have good proficiency in English. According to an analysis, students should have more than 5,000 vocabulary and reach Level 4 of college English in listening, speaking, reading, writing, and translation, in order to adapt to bilingual teaching courses^[3]. According to statistics, the results of the National College English Test for Level 4 and 6, which are important indicators of college students' English proficiency, are in a decreasing trend. Meanwhile, although the Ministry of Education has implemented a college English speaking exam system, not many students are qualified to sit for it, and the percentage of those who can achieve a passing grade or above is even lower. The uneven English proficiency and professional level of students create a difficult situation for the implementation of bilingual education.

4.2. Problems with the textbooks

The requirement of bilingual teaching is the use of original teaching materials from English-speaking countries, which are "pure" in language and readable. However, it is necessary to consider problems such as students' acceptability of these materials. In addition, the education system and differences in presentation are also problems in bilingual teaching. Although domestically published textbooks meet the

awareness of the students, they are not necessarily authentic in language, and their quality is not guaranteed in view of the short planning and publishing cycle. In some fields, there are no proper textbooks, and since the contents update rapidly, they often use English lecture notes for bilingual teaching. Therefore, at times, it is difficult to find bilingual teaching materials that are compatible with the major and suitable for the needs of both the teachers and students.

5. Further thoughts on the reform of bilingual teaching in the curriculum

5.1. Broaden the channels of training for teachers and improve teachers' level in bilingual teaching

At present, teachers in engineering colleges and universities come from different backgrounds, and they graduated from different colleges and universities. Although they have solid English foundation, they still favor technical English and professional English in the teaching process. Many teachers have not completely taken courses closely related to English teaching, such as education, psychology, and English pedagogy, during their schooling, and they lack experience in bilingual teaching, which weakens their teaching effect. Therefore, measures should be taken to strengthen the training of young teachers in English teaching theory and pedagogy. Teachers should also be allowed to pursue their doctoral degrees and study abroad, so that they can have some time to quietly focus on their lessons and make up for their weaknesses. Renowned teachers can also be invited to lecture at schools and introduce the cutting-edge development in their disciplines. In addition to teachers' personal efforts, relevant departments can establish an examination system similar to the *Language Proficiency Benchmark Test for Teachers* in Hong Kong and conduct regular English proficiency tests for those teachers involved in bilingual teaching. It is more important to establish a system rather than to rely on general appeals in order to improve teachers' English language skills [6].

5.2. Change the concept of learning, create a good learning atmosphere, and improve students' English proficiency

Why is it that China's long-term English learning has not been as effective as it should be? One of the main reasons is that the focus has been on the language itself, emphasizing language elements, language laws, and language knowledge as the center of language learning. The growth of students' listening, speaking, reading, and writing skills does not depend on the accumulation of language knowledge, but rather on the practice of the language [7]. In the practice of listening, speaking, reading, and writing inside and outside the classroom, students acquire English naturally through feeling, comprehending, accumulating, and using the language. An effective way of learning English is to be exposed to numerous English speeches and to use the language creatively. This would help in developing one's English verbal ability. Therefore, in the process of bilingual teaching in the future, it is necessary to pay more attention to and encourage students to use English when answering questions or during discussions, so that they may learn to think in English, talk in English, and solve professional problems in English.

5.3. Teaching according to students' characteristics

Teaching materials are the carriers of knowledge; without suitable teaching materials, bilingual teaching becomes like water without a source and wood without a foundation [8]. Since bilingual teaching has not existed long in China, many courses lack English teaching materials that are compatible with the syllabus. At present, there are many ongoing discussions and debates on the selection of teaching materials. It is definitely beneficial to introduce original English teaching materials to general courses such as mathematics, science, chemistry, and computer, but for courses related to railway signal [9], it may not be suitable to introduce original English teaching materials directly. However, it is necessary to compile suitable

materials in accordance to students' professional background as well as timely update and introduce the latest professional frontier technology ^[10]. Bilingual lectures and teaching materials are still needed in these courses.

6. Retrospect and prospect

In summary, bilingual teaching in China is still at an experimental stage. The overall progress of learning professional knowledge would be affected to a certain extent in the practice of bilingual teaching, considering the varying language proficiency among the students. Although certain achievements have been made in the teaching practice, there are still many problems that need to be considered and solved, mandating the joint effort of schools, teachers, and students.

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