The PBGS Teaching Mode and Study Based the Medical Informatics Engineering Course

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Abstract. The medical informatics engineering (MIE) course is a specialized core curriculum in medical college of biomedical engineering and computer class. The goal is mainly to teach students the medical information theory, technology and method, and how to apply the principle and method of modern information science and engineering technology to solve the problem in medical, pharma and biological fields. In this paper, the MIE course’s characteristics and the conventional teaching mode are analyzed firstly, and then the new Project-based group study (PBGS) teaching mode is proposed to improve the teaching effect of MIE course. Moreover, the implementation and the teaching quality evaluation system are presented in detail based on the PBGS teaching mode. The teaching effect shows that the exploration and practice in the curriculum teaching reform on the MIE course has a certain enlightenment significance to the curriculum education reform.

Introduction

As the branch of modern engineering science, the medical informatics engineering (MIE) has provided an important support for medical engineering and medical industry development and innovation. In today's knowledge economy era, the society needs high-level qualified personnel, so how to develop the new type of learning and education teaching mode has become a crucial problem to meet the emergence of the new teaching requirements on high engineering education for medical colleges and universities [1]. To this end, it is an important step to cultivate innovative talents and engineering talents to reform and improve the existing teaching model [2].

MIE Course and Characteristics

MIE is an interdisciplinary science based on basis multidisciplinary, such as the computer science, medicine, information technology and other disciplines. Therefore, the MIE course is the major required courses for computer science and technology, biomedical engineering (BME) undergraduate program, and it is also a development and deeply comprehensive course, The Fig. 1. shows the correlation between MIE course and other courses.

Through the MIE course of teaching, it can cultivate college students the efficient thinking model to deal with the medical engineering problems, at the same time it can impel the college students to master the application of information science and engineering in the medical science, the main purpose is to serve the cultivating applied and high-level medical engineering talents demand.

The characteristic of MIE course mainly includes: ① Comprehensive knowledge. As an emerging interdisciplinary medical information engineering, the MIE course content is related to information theory, basic medical science, software engineering, data processing and decision-making, etc., and the those knowledge are closely related with the crossing and comprehensive characteristics. ② The dynamic characteristics for the MIE course content. With the development of big data and cloud computing technology, new medical information technology and medical equipment are...
continuously invented and applied, and the existing hospital information system, medical radiation
system, and electronic medical record system are also updated more frequently. So this inevitably
leads to the MIE course content should be updated timely. The practicability of teaching system.
Because the MIE course is a typical practical curriculum, the simple and conventional teaching
method will obviously weaken the teaching effect. To let the students better learn medical
information processing knowledge and skills, the novel or improved teaching method should be
addressed and conducted during the MIE course teaching processing. Therefore, the teaching of MIE
course must be combined with the teaching goal. The whole course of the knowledge module is
sequential designed to settle a closely whole course basis firstly. Meanwhile, the course teaching
must be able to combine multidisciplinary information to make the students develop their knowledge,
and promote them to understand and grasp critical knowledge core of the MIE course system and
contents.

![Diagram of the Correlation on MIE Course and Other Courses.](image)

**Problems of the Traditional Teaching Model**

The problem-based learning (PBL) teaching model is a conventional teaching model which
adopted in the MIE course teaching usually, and it has greatly improved effect comparing with the
traditional teaching mode, but there still exist the following problems.

**Curriculum Teaching Methods and Assessments Still Need to be Improved**

The curriculum teaching methods and organizational forms still needs to be improved. Moreover,
there is still lack of multiple assessments, which has affected the students’ operation ability and
cultivating good engineering experimental habit. E.g. if the experiment group is divided too large, the
student has less chance to independently accomplish the training experiment or research work[3].

**The Students' Computer Application Ability and Knowledge Level Challenging Course
Teaching**

Based on teaching contents and teaching characteristics, the project-based learning is adopted and
it has gained a good teaching effect on the experimental teaching. But we found in practical teaching
class, if the students’ computer application ability and basic level has obvious disparity, when the
course ended, there is still a great difference of the quality for their finished training homework. How
can we make the same different levels of students in same class get balanced development and
achieve the curriculum academic goals, this is a valuable question to deep thinking and to be solved.

**The Problem-based Learning (PBL) Cannot Meet the MIE Course Teaching Requirement**

Based on PBL project drive method of teaching model, although it has made great progress, and
the students’ learning performance and academic level have obvious improved, but there still exists
some obvious shortage that does not match the cultivating high quality, comprehensive and innovative talents, in detail, it need to further consider students reasonable workload, to give students further full freedom, to guide students' autonomous learning in a more open way, to develop the students' ability of innovation in high level knowledge, etc.

How to Improve Proportion of the Comprehensive and Designed Training Programs

To solve those problems, the only way is to reform the teaching model and teaching method under the guidance of the scientific education [4]. On the basis of summarizing the experience of PBL teaching model, we have adopted the new feasible PBGS course teaching model and teaching management model to improve the quality of teaching step by step. Gradually explored a novel teaching model by teachers and students, it becomes a new teaching pattern of specialized medical engineering teaching course, and it is also an important computer teaching model innovation.

Basic Connotation

Project Based Group Study, shorted as PBGS, is an exploratory and task-driven teaching and learning mode, which is similar with project-based learning methods but it pay more attention to the role of the team. Its mode is designed by the teaching program based on the complex meaningful projects, and it impels the students to solve the proposed actual or authenticable problems. To lead, inspire and encourage students collaborated to complete the teaching project, so make them master the professional knowledge and ability study the scientific knowledge.

New Mode

With the support of university’s educational reform project, MIE course teaching team summarize the performance and experience of the PBL mode, including the teachers and students' performance and feedback, the assessment of the MIE course. Then the implementation process of PBGS in MIE course was improved, and the new PBGS teaching method is established. Moreover, the learning mode and the teaching quality test evaluation system are also constructed and conducted.

Construct Project-driven Centered Teaching Model

Different with the traditional teaching methods, the PBGS teaching model emphasis is given priority to the students' active selves learning based on the practice teaching program. The main directed teaching method is encouraging the teachers to select appropriate engineering application problem, to design the authenticity task, to lead independent exploration, stimulate and support the learner's high-level thinking, collaboration and debate, to encourage reflection on the learning content and process, etc. On the basis of in-depth study in the related theory of PBGS, the proposed project-driven centered teaching model aims to cultivate practical and creative abilities. In this new PBGS teaching model, the teachers are no longer dominate the knowledge and skills to students, they guide the students to figure out the ways to get the results, thus eventually gain as a result, obtaining new knowledge, enhance engineering practice ability, and to display and self-evaluation.

The teaching model mainly includes three phases: Project establishment, Projects Undertaken, Summarizes and evaluation. The teaching process include the following steps: design projects, organization team, team project approval, autonomous learning project undertaken, cooperation and exchange, submitted results, sumarizes and self-evaluation. As a result of the new PBGS teaching model through the theory teaching system and experimental teaching system, it can play an important role in the MIE personnel's comprehensive quality training system.

Through the interpretation of teachers bring students into medical field of information engineering processing and application, and then teachers gradually lead students into the study topic or sub-projects, for example, as teaching the Electronic Medical Record(EMR) chapter, the electronic medical records system, communication protocol mechanism, the traditional Chinese medicine (TCM) recommendation mechanism, the formulas of TCM prescriptions for TCM error intelligent
detection mechanism and the other various topics can be designed as a small projects or sub-projects to the student teams got by heterogeneity grouping method. The settled teams or groups study several special small projects or sub-projects respectively, and they take the way of cooperation and competition between groups in the process to carry out the study and research. Finally, through the research results demonstrate the project of the team or group, communicate and evaluate the final completion of the course of learning and teaching.

**Optimization the MIE Course Theory and Experiment Teaching Content**

The solid specialized theory knowledge and the necessary scientific research training and scientific research practice, which are vital parts in cultivating college students' practice and innovation ability, which are also the inherent training requirement of perfecting their knowledge structure. In practice, we adopt the project-driven centered teaching based PBGS teaching model, weakening the boundaries of theoretical system and experiment course system and integrating theoretical teaching and experimental teaching contents, design 10 project knowledge module such as: the EMR system, hospital information system, clinical information system, medical decision support, etc., and five comprehensive training programs, which can cover the whole MIE course contents well.

**Establish PBGS Teaching Quality Evaluation System**

To do a good job of supervision, inspection and feedback in time, it is important to ensure the teaching quality for the PBGS course. The comprehensive teaching goals determine the teaching should also be diverse information transmission and multiple evaluations [5]. That is comprehensive teaching activities should be through various channels, so it need to use a variety of evaluation means and methods to measure the students' learning and personal development. Only in this way, it can really play the function of teaching and evaluation, cultivate creative ability and the ability to solve practical engineering problems of outstanding students, really promote the students' comprehensive and harmonious development. Whereby, based on the basic idea of "project-driven centered mode", the setting of the curriculum teaching evaluation of MIE course core concept: innovation and development. Innovation means the innovation of the teaching content, method, design innovation project tasks, and students' independent innovation; Development is to point to pay attention to students' individual development, and the development of the teaching content.

<table>
<thead>
<tr>
<th>The PBGS based Teaching Evaluation System Quantitative Table for MIE Course</th>
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<tbody>
<tr>
<td><strong>Evaluation</strong>: A (5) + B (4) + C (3) + D (1) + E (0)</td>
</tr>
<tr>
<td><strong>Student assessment (50%)</strong></td>
</tr>
<tr>
<td>Accomplished project quality</td>
</tr>
<tr>
<td>Members participation degree</td>
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<tr>
<td>Members participation quality</td>
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<tr>
<td><strong>Teacher assessment (30%)</strong></td>
</tr>
<tr>
<td>Accomplished project quality</td>
</tr>
<tr>
<td>Interaction degree</td>
</tr>
<tr>
<td>Report &amp; summary</td>
</tr>
<tr>
<td><strong>Structural integrity assessment (20%)</strong></td>
</tr>
<tr>
<td>1. The most prominent technical characteristics</td>
</tr>
<tr>
<td>2. Choose one assessment A option and explain details</td>
</tr>
<tr>
<td>3. Suggestions for project deficiencies and improvement</td>
</tr>
</tbody>
</table>

Figure 2. Teaching Evaluation System for MIE Course.
Therefore, on the basis of course teaching evaluation system in Shandong university of Traditional Chinese Medicine, the MIE course teaching evaluation system has an emphasis on the following aspects: ① The evaluation target is not only the evaluation of students’ knowledge, skills, learning and teachers' teaching level, but the evaluate of innovation ability. ② In the teaching and evaluation of learning process, both evaluate the teaching strategies for teachers encourage students to explore and cultivate the innovative ability, and also to evaluate the achieved learning level of the students in the learning process. ③ Pay attention to the students status during the class teaching, including six aspects: Emotional status, attention status, participate status, communication status, state of mind, and generating status. Therefore, the MIE teaching team designed the evaluation system on MIE PBGS teaching, as shown in Fig. 2. After more than three years of modification, the quantitative evaluation gradually matured and goes well. Stage by stage, it becomes a new standard for the MIE teaching evaluation and provides important guidance and timely feedback for teaching.

**The Implementation Effect of PBGS Teaching Model for MIE Course**

In the curriculum teaching process, the PBGS teaching model of MIE course has obtained the good effect after more than three years of teaching practice. According to the teaching evaluation and questionnaires survey, the statistics results showed: ① Comprehensive evaluation aspects: the excellence rate was 90.7%, good rate was 7.5%, percent of pass is 1.8%. ② Integrated project design: 86.2% of the students think it's very suitable and attractive, 12.6% of the students think it's appropriate and attractive; ③ Course teaching satisfaction aspects: 97% students thought that is better, 2% students thought that is general; ④ Theoretical and experimental knowledge and skills to master aspects: 94.5% students think good, 4% students think generally, 1.5% students thought that poor; ⑤ 93% students thought that the individual project engineering application ability had been greatly improved, and the individual team collaboration and oral expression ability got promoted. ⑥ Students' suggestions mainly focus on the examination method, and most of them proposed to replace the traditional exam form by way of dynamic assessment and to protrude individual self-evaluation and the cooperation of team interaction.

**Conclusion**

With the implementation of PBGS teaching model, that is a promotion and development of PBL teaching model reform, it has become a breakthrough for the development of computer and information technology curriculum teaching in medical education, and it has established a new teaching mode with certain characteristics for MIE course.

In practice, PBGS teaching mode impel the student in the team work to solve practical engineering projects, and it has heavily improved to cultivate the students’ knowledge, ability, and the team cooperation spirit during the project implemental process. This successful conforms to the MIE teaching goals, can effectively enhance the students’ professional skill and employment competitiveness, and can highly meet the society’s requirements of applied technological talents.

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