

The Construction of Undergraduate Course Teaching Quality Evaluation System Based on PBL

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Abstract—In recent years, with the increasing demand for high-level practical talents and gradually accelerating the process of educational diversification, our undergraduate education is breaking the original training mode, from a single to diverse, from closed to open. PBL is “Problem-Based Learning” or “Problem-Orientated Learning”. This study intends to construct a set of teaching quality evaluation index system of PBL course, which has multi-level structure, clear index connotation and reasonable weight value, and can be popularized in the teaching practice of undergraduate education. At the same time, this study also plans to make a teaching Quality Assessment Questionnaire, which provides scientific evidence for further improving and developing the application of PBL teaching method in undergraduate education.

Keywords—PBL, expert consultation method, analytic hierarchy process, evaluation system

I. INTRODUCTION

PBL is “Problem-Based Learning” or “Problem-orientated Learning”, which is a kind of self-regulated learning model founded by Professor Barrows of American neurology in 1960s. It advocates setting learning in complex and meaningful problem situations, allowing learners to solve authentic problems through cooperation. In the process of problem-solving, learners can learn the scientific knowledge behind the problem, form the problem-solving skills, and cultivate self-regulated and lifelong learning ability [1, 2]. Since 1969, when Professor Barrows first established the PBL teaching model in the Canadian McMaster University, the PBL teaching method has achieved good results in western education. The practice of foreign education has proved that PBL is an advanced teaching mode that meets the requirements of modern personnel training [3, 4]. At present, PBL is the mainstream of international educational teaching reform [5–7]. Up to now, PBL has been widely used in

universities in the US, Canada, Australia, Bahrain, Chile, Egypt, UK, Indonesia, Malaysia, the Netherlands, the Philippines, Sweden, Switzerland and many other countries.

At present, our education evaluation system has established is mainly to carry on the quality control for the realization of the development goals, the evaluation of teaching quality in educational sub-goal is very few, the common and effective curriculum evaluation system has not been formed yet. In addition, PBL teaching and traditional teaching has a fundamental difference, PBL emphasizes the training of learning ability, teaching effect is not a test paper can be measured. The evaluation of it is based on the achievement of learning goals and the improvement of students’ ability. On the one hand, it assesses the teaching situation of teachers, on the other hand, the course developers can clearly understand the actual teaching of the professional courses, and to further improve and develop the PBL teaching model of the application process.

For these characteristics, the existing teaching evaluation system cannot be fully applied to the PBL course evaluation, if only using the previous teaching evaluation system, it is impossible to test the teaching effect of PBL.

The purpose of this study is to construct a set of clear-oriented, quantifiable, comparable, simple and feasible teaching quality evaluation system of PBL model, which can be used in the course of PBL teaching reform and course system improvement, to provide tools for scientific evaluation of PBL teaching effect. Therefore, the feasibility and actual teaching effect of PBL teaching mode in the course are further discussed to provide the reference basis for the popularization of PBL teaching method in other colleges and universities.

II. RESEARCH METHODOLOGY

Teaching activities are a complex dynamical system subject to many factors. When different regions and

colleges are carrying out teaching practice and exploring some brand-new teaching idea, they cannot mechanically copy the foreign classical model, they need to proceed from their own reality, creatively apply the teaching idea to practice, so it is very important to check application effect. The PBL teaching quality evaluation in our country's colleges and universities started relatively late, and the evaluation system and methods need to be improved. The construction of a reasonable teaching evaluation system is an indispensable part of teaching quality evaluation, is an important means to check the teaching effect and improve teaching quality. Only by establishing a scientific and reasonable teaching quality evaluation system, can we fully show the positive effect of teaching evaluation, according to the feedback information of evaluation, deepen teaching reform, and optimize the training process. The evaluation index system needs to be constantly enriched and perfected in practice so as to be more in line with science and reality and play a real role in teaching evaluation.

The complete evaluation index system includes reasonable hierarchy evaluation index, detailed index connotation, and the weight that defines the relative importance of evaluation index. In this paper, "Literature analysis optimization method" and "Expert consultation method" are used to select the evaluation indexes and determine the connotation of the indexes, and "AHP" is used to determine the weight of the indexes of the evaluation system.

A. Literature Analysis Optimization Method

This project will take the national undergraduate training goal, the society's need for talent training and the expected teaching effect of PBL model as the theoretical basis for constructing the index system, referring to relevant monographs, periodicals and papers at domestic and international, collating and analyzing relevant theories, and comparing various teaching evaluation systems proposed by current theoretical circles, at the same time, the project also consulted the research results of the evaluation index system of teaching quality in many domestic colleges and universities, seeking the scientific evidence for this study. Based on the advantages and disadvantages of each evaluation system, through the analysis of our undergraduate education background and the characteristics of PBL course, we initially select the evaluation indexes for the whole system at all levels [8].

B. Expert Consultation Method

In order to further explore the validity and rationality of the preliminary selected evaluation indicators, using the "Expert consultation method", we selected and recruited the authoritative experts in the fields related to

undergraduate education and PBL course teaching, established direct contact with the experts, organized the expert argumentation, collected the opinions from the experts on the screening of the evaluation indexes in the construction of the evaluation index system, and filled in the questionnaire on the screening of the indexes to collect the opinions of the experts, so as to make the opinions of the experts converge and unify, and revise and perfect the preliminary evaluation indexes [9].

C. Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a systematic approach that combines qualitative analysis with Quantitative analysis [10, 11]. It can systematize, digitize, and model complex problems, and quantify qualitative analysis based on human subjective judgments, the difference of each judgment element is numerical, which is suitable for multi-objective, multi-level and multi-index decision-making analysis. This project plans to compile the expert consultation scale for determining the weight, and use Analytic Hierarchy Process (AHP) to set the weight for each evaluation index in the revised index system.

III. RESEARCH CONTENTS

In the preliminary screening process of the evaluation indexes, based on the international universal teaching evaluation scale and the research results of teaching quality evaluation in domestic sister universities, the index system including three-level evaluation indexes was preliminarily drawn up, the first-level evaluation indexes include teaching Program, teaching strategy, and teaching effect. At the same time, we detail the process and purpose of teaching and learning, set up knowledge structure, course design, teaching attitude, teaching ability, knowledge mastery, ability improvement, quality training, 7 second-level evaluation indexes; According to the evaluation factors, it will be further divided into 23 third-level evaluation indexes: the content of course knowledge, the frontier of knowledge, the acceptability of knowledge, the course standard, the degree of difficulty, the teaching and educating, the cultivation of teacher's ethics, the work enthusiasm, the teaching language, the teaching skills, the classroom atmosphere, the foreign language level, the accumulation of new knowledge, the construction of knowledge system, the study interest, the problem-solving ability, the knowledge application ability, the judgment ability, the interpersonal communication ability, the cooperation ability, the thinking way improvement, the professional behavior improvement, the humanities literacy improvement. The indexes and their definitions are shown in Table I.

TABLE I. PBL TEACHING QUALITY EVALUATION INDEX SYSTEM AND INDEX CONNOTATION

General objectives	first-level indexes	Second-level indexes	Third-level indexes	The connotation of third-level evaluation index
Teaching quality evaluation	Teaching scheme	Knowledge structure	The content of course knowledge	Each workshop topic contains a sufficient amount of knowledge
			The frontier of knowledge	The teaching content tracks the frontier of the subject development and the latest research results, and pays attention to the actual effect of the knowledge
			The interdisciplinary nature of knowledge	The content of teaching covers a wide range of knowledge and attaches importance to cross-disciplinary links
			The acceptability of knowledge	Guide students to obtain knowledge for the teacher's own scientific research results or have been widely demonstrated that the view, there is evidence, students understand and accept
		Course design	The course standard	There is a clear teaching goal, and the teaching goal has the feasibility of realization
			The degree of difficulty	The problem is an open-ended one, the depth of the study is moderate, which accords with the educational level of the undergraduates and satisfies the adaptability of the students
		Teaching attitude	Teaching and educating	Rigorous scholarship, for students to raise different points of attention and respect
			Work enthusiasm	Enthusiastic in teaching, class passion, can mobilize the initiative of students
		Teaching thought	Role positioning	Have an accurate role positioning of teachers and students, willing to accept students' divergent thinking and questions, and encourage students to express their personal views and questions
			Teaching methods	Pay attention to the application of heuristic, research and discussion teaching methods, and pay attention to the cultivation of ability
			Teaching ideas	Familiar with PBL teaching model, the teaching process to discuss the breadth and depth of appropriate control, appropriate application of logical methods
			Teaching language	The expression is clear, concise, accurate, good at using the instructive language which has the enlightening significance
	Teaching strategy	Teaching ability	Teaching skills	Express clearly, concise, accurate, good at using the process control of instructive seminar with enlightening significance, effectively guide the discussion to the intended direction, and achieve the expected teaching effect
			Classroom atmosphere	Good at mobilizing the atmosphere of classroom discussion to create an open, fair and equal learning environment
			Foreign language level	The combination of teaching content can be better applied to professional foreign languages
			New knowledge accumulation	Students' understanding, mastery and application of the main contents of the curriculum objectives
		Knowledge mastery	Knowledge system construction	Students to the new knowledge, skills of imitation, independent operation and transfer, with their own knowledge system good integration
			Learning interest	Passion for further study of the major
		Ability improvement	Problem-solving ability	The ability to discover important facts, to formulate learning goals, and to use data effectively for logical reasoning
			Knowledge application ability	Ability to apply knowledge acquired in the course to other problems
			Judgment ability	The ability to make correct judgments based on available information and clues
			Critical thinking	Good at questioning and analysis, can dialectical, multi-angle thinking problem ability
		Teaching efficiency	Interpersonal communication ability	The ability to express opinions and share ideas and opinions
			Cooperation ability	Ability to work with others to accomplish a task
	Quality training	Quality training	Thinking mode improvement	Through the participation of the learning process, to achieve the recognition of learning methods, imitation and try
			Professional behavior improvement	Practice discipline, professional responsibility, professional identity, professional ethics
			Humanistic literacy improvement	Personality, temperament, self-cultivation and other internal quality improvement

IV. EVALUATION INDICATORS

A. The Determination of the Weight of the Evaluation Index

According to the basic principle of AHP, the expert consultation questionnaire for determining the weights of

PBL curriculum evaluation system is compiled, and the detailed explanation of AHP and the rules for filling in the form is given in the questionnaire, considering that the experts may not be familiar with this kind of consultation form, the scale of comparison judgment matrix is transformed into a simple rating standard table. 22 experts

who had participated in the screening of evaluation indicators before were invited to conduct a questionnaire survey: 50 questionnaires were distributed to experts, 47 questionnaires were returned, and 47 questionnaires were valid. The effective rate of the questionnaire was 94%.

B. Test of Internal Consistency of Expert Opinions

The consistency test is carried out for each judgment matrix data of each expert, if the consistency test results cannot pass, check the relationship between the elements of the matrix is appropriate and make appropriate adjustments, continue to let the experts revise the statistical results. Finally, the Consistency Ratio (CR) of every matrix is less than 0.1, which means that the judgment matrix has satisfactory consistency [12].

C. The Rationality of Evaluation Index Screening

The teaching activities are carried out to pass on knowledge, exercise ability and cultivate quality. The teaching quality evaluation of PBL course for undergraduates focuses on the teaching effect as well as the teaching process, in particular, the ability to improve and quality of training considerations. In order to improve the application and popularizing value of the evaluation system in this research, the selection of evaluation index is based on the reference to the previous research results, and fully considers the macro-educational background and high-level educational requirements of our country, as the basis of evaluation index screening.

1) Based on the society and the talented person development demand

Social demand itself is not a factor of education quality, but with the transition of economic system, social demand also has an increasingly profound impact on undergraduate education. The social needs lead to the formation of the concept of the quality of undergraduate education, which affects the process of the formation of the quality of undergraduate education. From the perspective of social development, the rapid development of economy, science and Technology, politics and culture urgently need a large number of high-quality high-level professionals with strong innovative consciousness, solid academic foundation and good humanities accomplishment. The degree to which the undergraduate students can meet the needs of the society is a reflection of the quality of undergraduate education. From the perspective of human development, the higher the degree of the students, the more they pursue their own intellectual development, ability enhancement and spiritual improvement, and to what extent the school can meet the needs of students, also reflects the quality of undergraduate training. Therefore, the establishment of undergraduate training quality evaluation standards, no matter how the index system is determined, should include these elements.

2) Based on the expected effect of PBL teaching mode

The biggest difference between PBL and traditional teaching lies in changing the traditional "Teacher-centered" to "Student-centered", "Knowledge indoctrination" to "Knowledge acquisition by students", "Classroom teaching" to "Group cooperation to solve ill-structured problems". PBL helps students construct flexible knowledge base, develop sustainable learning methods, and cultivate

students' high-level thinking skills through problem-based and group cooperative self-directed learning [13]. Because the implementation of PBL model is based on real problem situations, the openness of problem-based learning and the process of problem-solving determine the evaluation of PBL learning effect is different from the traditional teaching evaluation. Therefore, the effective results of PBL teaching should be reflected in the improvement of students' learning attitude, self-study ability, critical thinking ability, knowledge application ability, clinical reasoning ability and interpersonal communication ability [14]. When we evaluate the teaching quality of PBL course, we should fit the training goal, match the evaluation with the teaching, and not neglect the evaluation of the expected teaching effect [15].

In this study, based on our undergraduate training objectives and social and talent development needs, the formative evaluation and summative evaluation of the two evaluation methods organic combination, the formative evaluation is to realize the evaluation of each link in the teaching process, and the summative evaluation is to realize the evaluation of the short-term and long-term effect of the course teaching. On the one hand, the characteristics of general curriculum requirements are extracted as evaluation indicators, and on the other hand, the evaluation indicators are included to evaluate the degree of realization of the specific teaching objectives of PBL curriculum, finally, it forms the characteristic evaluation index of undergraduate PBL teaching quality. On this basis, fully combined with the advisory opinions of authoritative experts, the rationality of screening indicators was further demonstrated.

V. CONCLUSION

In this study, the method of "Literature analysis optimization method" and "Expert consultation method" were used to select the evaluation indexes and determine the connotation of the indexes, and the method of "AHP" was used to determine the weight of the evaluation system, to construct a PBL model teaching quality evaluation system including three-level evaluation indexes, and to test the enthusiasm, authority and consistency of the experts in the process of the system construction, the results support the high reliability of the experts' opinions. According to the established evaluation system of PBL teaching quality for undergraduates, a questionnaire for PBL teaching evaluation is developed scientifically from the aspects of questionnaire structure design, answer item grading and evaluation, and questionnaire quality control. The questionnaire's retest reliability, internal consistency reliability, rater reliability, content validity and construct validity were tested by field survey. The results showed that the questionnaire had good reliability and validity. Finally, this research forms a PBL quality evaluation system including 3 first-level indexes, 8 second-level indexes and 27 third-level indexes and a set of teaching quality evaluation questionnaire, which provides practical tools and scientific basis for the application and popularization of PBL teaching mode in domestic universities. At the same time, the construction of the evaluation system and the

compilation of scientific questionnaire can also provide reference for the evaluation of teaching quality in colleges and universities.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

CC and CJ conducted the research; RG analyzed the data; ZZ wrote the paper; all authors had approved the final version.

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