Case Studies on the Development of Pre-career Teachers' Information Technology Application Ability

——take "information technology and curriculum integration" course reform as an example based on TPACK

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Abstract—**21st century is the information age. The research about how to develop pre-career teachers' information technology application ability is becoming a hot topic for research at home and abroad. Pre-career teachers should be trained to improve their information technology application ability, which is the mission of the higher normal colleges. Taking "information technology and curriculum integration" course reform as example, the paper discussed the method to improve pre-career teachers' information technology application ability, by through the comparative analysis on the effect of course reform before and after.**

Key words—TPACK; pre-career teachers; information technology and curriculum integration; information technology application ability

I. RESEARCH BACKGROUND AND SIGNIFICANCE

With the widespread application of information technology in the curriculum teaching, the deep integration of information technology and education has been more and more attracts people's attention. In the international [1] [2], led by the US, after experiencing the two stages of emphasis on "technology" and "student" autonomous application of technology (the main mode of integration in the first stage is Web Quest, the main mode of integration in the second stage is TELS), AACTE first realized that the former two stage of educational information process without careful attention to the "knowledge required by teachers " and "the important role of teachers in the integration". This will have a direct impact on the education information. In 2008, AACTE put forward "Technological Pedagogical Content Knowledge", referred as TPACK. TPACK has attracted a lot of scholars at home and abroad. It is regarded as the most important development in the field of information technology and curriculum integration in the past 25 years".

In China, after many years of education information engineering, teachers' ability has become an important factor affecting the depth of integration. "The construction of teachers is the basic guarantee for the sustainable development of educational information. Information technology application ability is an essential professional ability of teachers in information society." This view has been endorsed by all walks of life. In combination with the actual situation in the country, the Ministry of Education issued a series of documents which under the background of the domestic and foreign research on the TPACK. In October 25, 2013, the Ministry of Education issued a document entitled "opinions on the implementation of the national primary and secondary school teachers' information technology application ability enhancement project"(Teacher [2013] No. 13). In May 27, 2014, it issued a notice entitled "standard for information technology application ability of primary and secondary school teachers (trial)" (Teacher Office [2014] No. 3), hereinafter referred to as the "ability standards". In May 30, 2014, it issued a notice entitled "information technology application ability training curriculum standard for primary and secondary school teachers (trial)" (Teacher Office [2014] No. 7), hereinafter referred to as the "curriculum standards". Essentially, the goal of TPACK is consistent with the goal of our country's ability enhancement project. They are all in order to enhance the teachers' information technology application ability（hereinafter referred to as IT application ability）, to promote the deep integration of information technology and education.

Both domestic and international are aware of the "teachers has the important role in information technology and curriculum integration", the normal university started struggling to find urgent solution for the problems like how to strengthen students' IT application ability and how to strengthen students' deep integration ability of information technology and teaching. Shanxi Datong University as one of the newly established comprehensive university (the predecessor is Yanbei Normal College, mainly in normal education), starts the comprehensive reform for the course of information technology and curriculum integration from the first half of 2014. This article will be the course of reform as background, does the case study on the development of pre-career teachers' IT application ability.

II. "INFORMATION TECHNOLOGY AND CURRICULUM INTEGRATION" COURSE REFORM PROGRAM

A. Establish the Course Objectives [3]

Course objective is the general requirements of the educational purpose of a course. Establish the course objective is the key to the course implementation. It guides the basic direction of course teaching, and will determine the students' acceptability of the course.

TPACK and China's "curriculum standards" gave us the revelation to pay attention to "territory pulse". We should establish the course objectives according to the school's orientation and the characteristics of the pre-career teachers. Shanxi Datong University with local characteristics is a comprehensive university. It is mainly to cultivate application-oriented talents to serve the local. It has become a center in Datong and its surrounding areas. It is a center for the development of applied and innovative talents, a center for cultural and technological innovation, a demonstration base for production, learning and research, and a training base for basic education teacher, and a learning base for community lifelong learning. College of education science and technology assumes the application and popularization of the basic education informatization and training of primary and middle school teachers' educational technology ability in the north area of Shanxi Province. Based on these, the train application-oriented talents with innovative ability are the general teaching objectives of this course.

Specific teaching objectives of this course are for supporting theory and practice bases for integration of information technology and curriculum in primary and secondary school teachers, and developing practice and research capabilities of information technology and curriculum integration in primary and secondary school teachers, and improving the application of information technology in primary and secondary teachers' teaching level and to enhancing IT proficiency. Specific objectives are: to make the pre-career teachers systematically understand the basic theory of information technology and curriculum integration, it is possible to use the advanced educational theory into practice; to train pre-career teachers for their instructional design capability based on IT environment, to enable better planning of teaching according to the actual situation; to be able to use technological tools (especially disciplinary technical tools) to require, process and produce teaching resources suitable to different subjects, to train and improve pre-career teachers' disciplines technology capacity, in order to meet the future educational need.

From emotional and attitude aspect, the course should focus on training students to apply information technology awareness; from knowledge and skills perspective, the course should focus on subject related information technology infrastructure to equip students with the knowledge and basic skills; from educational applications perspective, the course focus on training to improve students' discipline information literacy, so that students have the ability to use information technology to solve the education problem, like the ability to integrate information technology and discipline.

B. Course Reform program design flow

After determining the course objectives, based on the systematic instructional design model, we present the reform program design flow of the course as indicated by Figure 1 [4].
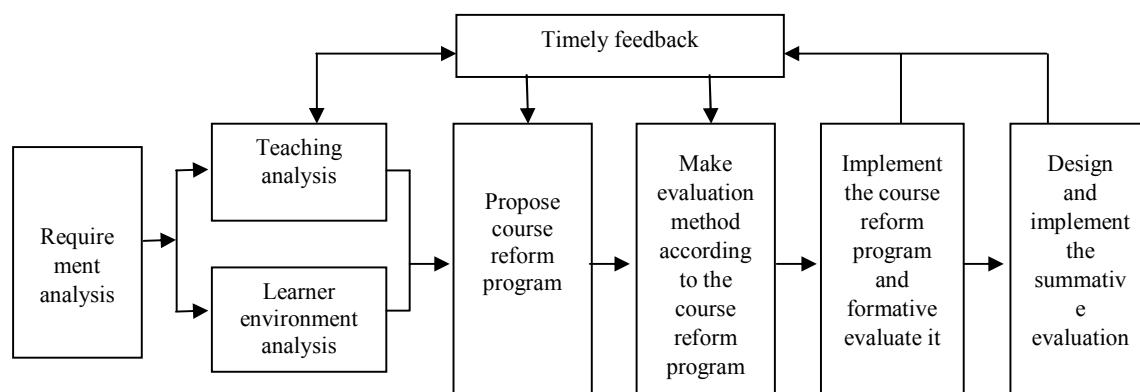

Figure 1 Course reform program design flow chart

C. Specific Course Reform Program

1) Learner Analysis

The course reform program is carried out in 2014 spring semester enrollment of normal students in the implementation, with number of elective classes altogether at the end of 79 people, mainly in the majors of mathematics and application mathematics, primary education, ideological and political education, physics and other professionals, mainly for the 2011 year. They have already learned the basic curriculum of teacher education, such as "Computer Basics", "psychology", "Mandarin" and "Teachers' write skills" courses, and professional foundation courses of their discipline, accessed to a certain amount of content knowledge (CK), technological knowledge (TK) and pedagogical knowledge (PK). For students of primary education, they have already learned more teacher education courses, including education, psychology, pedagogy and graphic design, animation and Web design course. They are in a higher level in knowledge and skills, so specific course contents are required. According to personnel training program, the semester at the same time offer teacher education courses "education (including professional ethics)", "high school thought political lesson teaching method", "multimedia courseware" (Physics) courses, also open in the 7th semester "Mathematics Methodology", "physics teaching skills" courses etc. . These courses will help students improve their IT teaching ability. In the course content, we should highlight the characteristics of this course, to avoid duplication of teaching content.

2) Determining Course Reform Program

Combined with the training objectives of the course (from previous heavy knowledge training to heavy ability training) and learner analysis, we determine the focus of the course teaching is improving students' Technical Knowledge, especially the knowledge of subject software(TK),Technological Content Knowledge(TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK), etc. and on this basis learner will master the theoretical knowledge to technically support practical design. Specifically, the main task is "to help pre-career teachers master the basic theory of information technology and curriculum integration, master common and discipline software, use digital education resources, network teaching platform and other technical resources, and according to the theoretical guidance, make use of information technology to conduct teaching design, and make the integration of theoretical knowledge into practice for better use. Because it is the first time for the implementation of course reform, so we will only reform the content system of the course as shown in Table 1.

TABLE 1 CORRESPONDING RELATIONS BETWEEN COURSE REFORM PROGRAM AND TPACK, IT APPLICATION ABILITY

Course Module	Main Contents	Corresponding TPACK Elements	Corresponding IT Application Ability Dimension
First module: the overview of" "Information Technology and Curriculum Integration"	The background and significance of Information Technology and Curriculum Integration，the connotation of integration, theoretical basis, advancing process of educational information in China, interpretation of TPACK, and interpretation of ability standards.	Interpretation of TPACK	Interpretation of ability standards
Second module: Information Instructional Design	The basic theory and method of Information Instructional Design, the basic process and design template of instructional design based on knowledge point and unit, etc.	PK、TPK	planning and preparation
Third module: The design and development of informational learning resources	The overview of" informational learning resources, the application form of information learning resources, collection and processing of learning resources, the operation and teaching application of the subject software, the design and recording of micro video, management of informational learning resources, etc.	TK、TCK	technological literacy
Fourth module: Teaching model and case analysis of Information Technology and Curriculum Integration	Classification of information technology and curriculum integration, introduction to the common mode of information technology and curriculum integration, introduction to the mode of information technology and text or science curriculum integration.	TPK	planning and preparation
Fifth module: The evaluation of "Information Technology and Curriculum Integration"	The evaluation of integration program, resources and the concept, the evaluation of the effect of classroom implementation.	TPACK	evaluation and diagnosis

III. THE EFFECT EVALUATION OF THE DEVELOPMENT OF PRE-CAREER TEACHERS' IT APPLICATION ABILITY BASED ON TPACK

A. Effect Evaluation Methods

The research adopts questionnaire, participant observation and interviews to evaluate the effect of course reform. According to "ability standards" and the actual situation of this course, we designed self-questionnaire. Questionnaire is mainly used for measuring student IT application ability before and after the implementation of the course. Questionnaire mainly contains three aspects. First, the student's basic information, include the student's gender, grade and profession. Second, the application ability self-rating scale in the form of self-evaluation, including technological literacy (10 questions), planning and preparation (10 questions), evaluation and diagnosis (5 questions), which is based on three aspects and contains 25 questions. Each question uses five degree of judgment "very good, good, normal, bad, very bad", in turn encoded as the number "5" to "1". Third, open-ended questions are used for collecting proposals for students on the course reform.

Participant observation method is mainly used in the implementation process of the course reform and in observing the student's attitudes and knowledge toward course reform.

Interviews method is mainly used to know the students' understanding of the course, the self-evaluation of the effect of the course study, and the suggestions on the course reform after students have leaned the course.

B. Pre-career Teachers' IT Application Capability Level Pre-test

Before the implementation of the course reform program, 79 copies of the questionnaire was sent and recovered from 79 enrolled students. No invalid questionnaire has been found form the entire recovered questionnaire. Valid rate was 100%. Data from questionnaire has been collected using Excel software for statistical analysis, corresponding to various levels of problems and calculate average value. In order to facilitate comparative analysis, the average scores are translated into percentage, which is shown in the Figure 2.
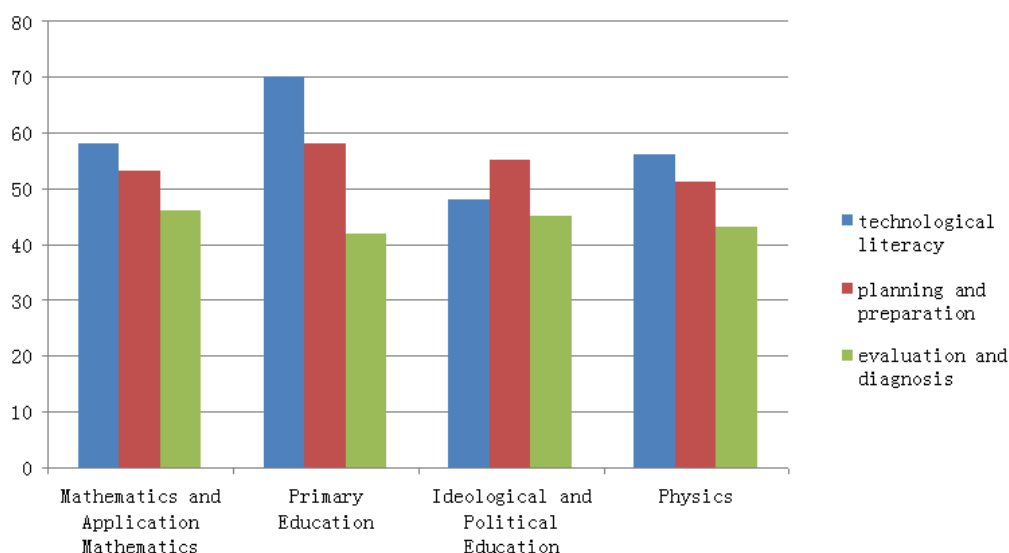

Figure 2 Pre-test results of pre-career teachers' IT application ability level

As can be seen from Figure 2, the technological literacy overall is superior to planning and preparation, evaluation and diagnosis in these students' IT application ability; overall IT application ability of the students of primary education majors is superior to the other two majors, and it is consistent with preliminary of learner analysis characteristics before.

C. Pre-career Teachers' IT Application Capability Level Post-test

Pre-career teacher's IT application capability Level post-test adopts individual interview, group interview and questionnaire methods [5].

1) Analysis of individual and group interviews

The selection method of individual interview object is "purposive sampling". In order to ensure the validity and extension of the study, we combined strength sampling and

stratified sampling. Interview objects of this study are 4 students in grade 3 according to the profession (1 male and 3 females).The main reasons for their selection are: a)enrolled students sex ratio is about 1:3, so the interviewees are 1 males and 3 females; b) select the students in grade 3, mainly because they already have in-depth understanding of the profession, and faced with employment, consciousness of improving the IT application capability is relatively higher than the grade 2; c)through observation, it was found that the 4 students are interested in this course, and are willing to provide true information. Based on the above considerations, the selection of them as interviewees increases the validity of the study.

The following are the specific information of the 4 pre-career teachers to visit:

Xiao Ren, Shanxi Datong University, 2011 Mathematics and Application Mathematics major student, female, undergraduate, on behalf of ordinary normal students.

Xiao Zhao, Shanxi Datong University,2011 Primary Education major student, female, undergraduate, on behalf of normal students with better IT application capability.

Xiao Yang, Shanxi Datong University, 2011 Ideological and Political Education major student, female, undergraduate, on behalf of ordinary normal students.

Xiao Liu, Shanxi Datong University, 2011 Physics major student, male, undergraduate, on behalf of ordinary normal students.

According to the interview outline, the interviewers talked about their views of this course reform, learning experience, and their changes in the level of IT application capability. The following are their interview summary.

Xiao Ren: I think this course would be the same as other theoretical courses in Mathematics and Application Mathematics major, a bit dull, coupled with my general level of IT application capability, and estimated that I will not have a big harvest. But fortunately, because the teacher is teaching with software , not only learning the material collected and processed, but also learn commonly used educational software, science software, and provides us with information instructional design templates; these are very practical for me, I feel a lot better as compared to the previous design and technological capabilities .

Xiao Zhao: This course is a big help for me. First, in technical aspects, unlike the previous use as just a single example, the PS technologies we learned are fully used in teaching resource pack development and I really understand the role of technology in teaching; second, the templates and the models are very practical, only by simple modification when applied, very convenient. Also I feel my instructional design capacity increased. As suggestion, I think teaching philosophy is critical, which is important – theory knowledge or application

capability? As we are now, we pay attention to the application capability, and it makes more sense for us, it can also help us in future.

Xiao Yang: In my opinion anything is meaningful. My harvest of this course: "the collection and processing of learning resources and software operation" are what we need. Before we only understand the simple office operation, after the course, my technological ability has great progress. In the teaching design, I will be able to design a reasonable teaching unit package in the software technology for the technical support. The view on this course mainly is: we should combine the technical and teaching methods in the teaching in the information age.

Xiao Liu: Upon completion of this course, I feel a lot. This course has changed my ideas in the past. I understand the new teaching ideas. At the same time, let me know more teaching software, my level of the technological literacy is better than before. I feel the superiority of this course. After the completion of several operations, my application capacity also increased a lot. Advice: the combination of teach and watch videos in teaching reduce learning outcomes, it is better to change the other way.

At the time near the end of the course, we had a brief interview, and by issuing paper tips for all students, and we collect learning outcomes and opinions to the course. After the analysis of the collected contents, summaries are below.

First, the ideas of transformation:

"In the course of this study, my greatest achievement is to accept new teaching ideas."

"My level of knowledge has improved. The past chalk and talk teaching seems to lose, whereas the combination of technology teaching is in a completely different feeling, technology increasingly strong my desire to learn."

Secondly, technological literacy changes:

"Great harvest is to have learning the software which is previously only heard and not used such as website design software, Flash, Geometer's Sketchpad, Science Word etc."

In addition, instructional design capabilities (planning and preparation) changes:

"I learned a lot of techniques, and know how to apply these techniques to design a teaching."

Through the above interviews, as well as the summary of the information on paper tips, we can find: Through the "Information technology and curriculum integration" course reform, the students generally think their IT application ability was with varying degrees of improvement, the course learning has a certain foundation and preparation in the future teaching work, and they also think that their teaching concept has changed. We

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also found that the problem from the interview, such as how to reform teaching method? This is our follow-up research question.

2) Analysis of the survey results

In interviews after the course, we also once again issued a questionnaire. Through data analysis we found that by "Information Technology and Curriculum Integration" course reform, various professional pre-career teachers' IT application ability levels have improved. Specifically as shown in Table 2. For more intuitive display of changes of pre-career teachers' IT application ability levels before and after the course, we convert the data in Table 2 to graphics in Figure 3.

TABLE 2 STATISTICAL COMPARISON OF PRE-CAREER TEACHERS' IT APPLICATION ABILITY LEVEL

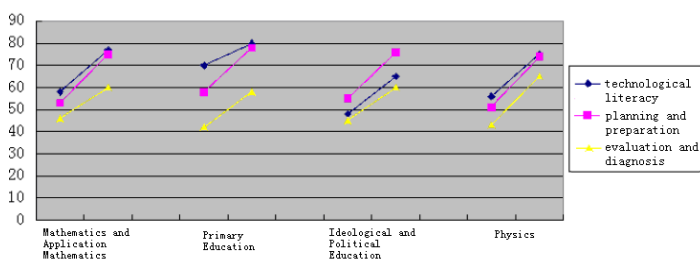| Major	Category	Technology literacy	Planning and preparation	Evaluation and diagnosis
Mathematics and Application Mathematics	Pre-test	58	53	46
	Post-test	77	75	60
Primary Education	Pre-test	70	58	42
	Post-test	80	78	58
Ideological and Political Education	Pre-test	48	55	45
	Post-test	65	76	60
Physics	Pre-test	56	51	43
	Post-test	75	74	65

Figure 3 Statistical comparison of pre-career teachers' IT application ability level

IV. CONCLUSIONS AND REFLECTIONS

Through research, we found that changing the concept of culture of pre-career teachers, and reform course contents based on the needs of learners can enhance the pre-career teachers' IT application ability, and get outstanding performance in technological literacy and planning and preparation. This also shows that the course reform based on TPACK is meaningful. In the first reform, we only reform training objectives and knowledge system, teaching mode is still as in ordinary multimedia classroom with lectures and discussions, evaluation methods mainly adopt teacher's evaluation. It also affects the effect of course reform to some extent.

Furthermore, we will continue to increase the intensity of course reform in the professional and public classes. We will

reform teaching model, teaching methods and evaluation methods based on the existing basis. In the teaching model, we will try the mixed teaching model of students' online self-study and teachers' classroom teaching. This model will help to train pre-career teachers' capability of 'learning and development' dimension. For student's online self-study, we have developed the web-based course. At the same time, "Microteaching" bundling with this course, students will be able to implement the instructional design on "Microteaching" course. It will develop their capability of 'organization and management' dimension. In teaching methods, in addition to taking the discussion, demonstration, lead, case support, task-driven teaching methods, etc., we will also take the research study supported by technology, to encourage students to participate, to feel, to complete the teaching content of the course in the process of practice. In evaluation methods, teacher, learner, learning companion, online courses are the evaluation of the objects, by using a process-based evaluation, and combination of subjective evaluation and objective evaluation.

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