The Integration of Network Technology and Problem-Based Learning in Higher Education Curriculum Development in China

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Abstract—In the 21st century, traditional education faces many challenges. In the post-popular era, opportunities have emerged. Emerging internet education is replacing traditional education and the combination of internet technology and innovative teaching (problem-based learning) has become a popular educational topic. This study applies this innovation to higher education programmes (science, technology and social science programmes). A review of 100 scholarly articles on the use of network technology and innovative teaching (PBL) in higher education curriculum found that the main applications were in computer education, medical education and language education. Addressing problems or challenges that arise in traditional education. As a result, higher education teachers and students can be well adapted to this way of learning and substantial recommendations are made for the future development of higher education in China.

Keywords-Problem-based learning (PBL); Network technology; higher education; Creative teaching model; Computer education; Medical education; Language education

1 INTRODUCTION

According to a UNESCO survey, higher education is affected to varying degrees by the new coronavirus in countries around the world, including up to 200 million higher education students [1]. Traditional education is not meeting the needs of students and teachers, and issues of teaching methods and educational technology need to be adapted and flexible. As educators, it is important to consider how to encourage the use of network technologies and other aspects of pedagogical creativity in teaching practice [2]. Creativity and innovation in education are increasingly important for the development of a knowledge society in the 21st century. As such, educational reform is seen as central to the development of creativity and innovation. Researchers have emphasised the need for greater promotion of network technologies and innovative teaching and learning in this new learning paradigm. This requires new approaches (Problem-based learning) and finding ways to promote students' motivation and skills for self-directed learning [3].

Education in China is in a transitional period of development from traditional education to online education [3]. Successful progress has been made, both in terms of educational ideas and

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concepts to teaching materials, teaching techniques and teaching methods. Especially in recent years, this innovative education has become a popular symbol [4]. The aim of this "fashionable" teaching is to raise all types, levels and requirements of higher education personnel for the 21st century.

2 PROBLEM-BASED LEARNING IN HIGHER EDUCATION

Problem-based learning (PBL) first originated in medical education in the 1950s and has become an internationally popular teaching method. Unlike traditional teacher-centred teaching models, PBL is a student-centred approach to teaching and learning, and its use in curricula and teaching is beginning to gain ground around the world. Barrows [5] describes the concept of PBL as learning through the efforts of students, who in turn develop their own understanding and problem-solving skills. This approach is based on authentic problems, small groups and self-directed learning. Dolmans and Schmidt state that the aim of PBL is to help students develop rich cognitive models of the problems presented to them [6]. Savin-Baden argues that teachers who typically use PBL methods often do not have the explicit goal of developing students' 'criticality', and independence [7].

2.1 Characteristics

Some scholars have described the characteristics of PBL. Engel's description of the characteristics of problem-based learning is that it is cumulative, integrative, progressive, and consistent, as well as coherent [8]. Savin-Baden presents six aspects of problem-based learning and argues that the important distinction lies in the way in which the PBL model is implemented. Knowledge, learning, and student roles are conceptualized and presented in the course. Creativity can be applied to PBL in any field. although the core issues vary across disciplines, the issues associated with PBL have characteristics that transcend their field [9]. Torp and Sage [10] define the characteristics of PBL as the emergence of focused, real-world problems around the investigation and resolution of messy, experiential learning. Students are described as engaged in problem-solving, seeking out potential problems and the conditions needed for a good solution, and becoming self-directed learners in the process.

2.1.1 Student are primarily responsible for their own learning

Problem-based learning (PBL) is a learner-centered approach. As such, students need to benefit from the knowledge, skills, or experience they gain to solve real-world problems. Responsibility for the problem-solving process needs to be taken by the learner (student) and learner motivation is increased [11]. In PBL, learners detail what they know and what they need to learn. Students need to take responsibility for bringing this information back to the group to help develop solutions.

2.1.2 What was learned and what was discussed learned

Barrows [5] suggests that learners should examine the PBL process so that they can better understand what they know, what they have learned, and how they are performing. Problem-based learning is considered an engaging, motivating, and participatory experiential learning method, learners are often very close to the immediate details of the problem and the proposed

solution. The purpose of the post-experience debriefing process is to consolidate learning and ensure that the learning experience is reflected upon [12].

2.1.3 Activities that are valued in the real world

Component Savery and Duffy [11], Stinson and Milter [13], Wilkerson and Gijselaers [14], and MacDonald [15] discuss extensively the rationale and guidelines for selecting authentic problems in PBL. Bransford, Brown, and Cocking [16] argue that the knowledge and skills learned through PBL are transferable to the real world or society.

2.2 The Challenges of PBL in Global Higher Education

The use of PBL in practice often presents a number of pedagogical challenges that need to be addressed by educators. The following are some of the challenges that are often encountered in the practice of PBL in global higher education [17].

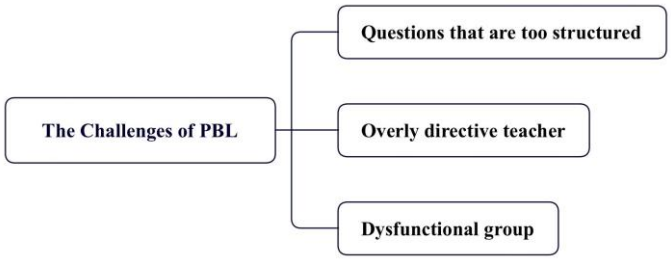

Figure 1. The Challenges of PBL in Global Higher Education

2.2.1 Questions that are too structured

Questions that are too structured. What teachers need to consider in designing effective questions is that in some PBL courses in higher education, students are faced with questions that are too simply structured. As a result of these problems, students are not challenged to actively construct knowledge. Secondly, the questions are often not contextualized to the real world or society. In such cases, PBL does not stimulate students to learn constructively [18].

2.2.2 Overly directive teacher

Overly directive teachers are also one of the challenges. Many university teachers who use PBL are overly paranoid, which Hendry, Ryan and Harris [19] argue can lead to problems such as tension and conflict in the classroom and student absenteeism. Problems can also arise if university teachers are too lenient in classroom management, for example by being too passive. The PBL learning process can also be hindered if the dominant tutor in the classroom gets in the way of the learning process. This would not be a student-centred way of learning [20] [21].

2.2.3 Dysfunctional groups

This led to dysfunctional groups. Hitchcock and Anderson found through their research that some university groups were too apathetic. Students questioned PBL teaching and did not believe that learning could take place through group discussion. Some groups were passive in their learning [22]. Dolmans et al. [23] argue that PBL leads to ritualistic behavior, which refers

to specific kinds of cognitive activities in the group, such as the elaboration of prior knowledge. In these groups, new ideas are brought into the discussion without making connections to other ideas. The problem with many of the groups, the research suggests, is that although students still appear to be engaged in their course work, this behavior is a ritualistic one. Some group members were not prepared and left it up to other group members to prepare. This can lead to a decrease in participation from those university students who are initially motivated [24].

2.3 The Challenges of PBL in Chinese Higher Education

In recent years, PBL has been used in higher education teaching in China. Many teachers and curriculum designers are experimenting with PBL in the medical field, both at the curriculum level [25] and the institutional level [26]. There are several challenges in introducing PBL into Chinese education [27].

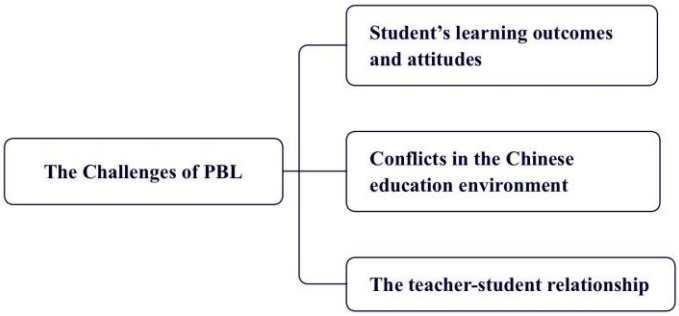

Figure 2. The Challenges of PBL in Chinese Higher Education

2.3.1 Student's learning outcomes and attitudes

Frambach et al. [28] found that PBL did not reach a consensus on student learning processes and outcomes. Students' attitudes and habits of learning are considered challenges. As China is an exam-oriented education for students, this deeply shapes their conceptions of learning, knowledge acquisition, and passing exams [29]. Chinese higher education students have been passive learners, accustomed to following teachers' instructions and respecting their authority, which has largely hindered the application of PBL in Chinese higher education programmes [30].

2.3.2 Conflicts in the Chinese education environment

The challenge of PBL in Chinese high school education is the contradiction or conflict between the Chinese educational environment and problem-based learning. The Chinese higher education system tends to design a traditional subject-based curriculum. The focus is on the teacher delivering the lesson. To some extent, collaborative curriculum development and team teaching are discouraged [31].

2.3.3 The teacher-student relationship

The implementation of PBL in Chinese higher education will lead to an impact on the relationship between teachers and students. The traditional teacher-student relationship, which emphasises the dominance of the teacher in the teaching process, may undermine the

implementation of PBL [32]. the implementation of PBL will lead to a shift from teacher-centred teaching to independent student-centred learning. This will require a shift in the role of the teacher from that of a guide to that of a facilitator. Chinese higher education teachers may recognise the value of giving students autonomy, but they may still maintain a high level of intervention in their students' learning process, which is the opposite of what PBL emphasises [33].

3 THE INTEGRATION OF NETWORK TECHNOLOGY AND PROBLEM-BASED LEARNING

Chinese universities have successfully addressed many of these challenges through the use of network technologies combined with PBL, which is revolutionizing higher education. It has contributed to the internationalization of higher education in China. PBL as an innovative model of teaching and learning in Chinese higher education has some shortcomings that many scholars have found through their research that higher education programs can be addressed through the use of technology support combined with PBL [34] [35] [36] [37].

Technology as a tool will facilitate human development. Technology can be used in a wide range of areas to meet human needs. These technologies include computer or network technologies [38]. Kokotsaki, Menzies, and Wiggins concluded through their research that the factors that facilitate PBL include current network technologies [39]. Particularly in the Covid-19 period, PBL coupled with the support of technology could be better applied to online courses.

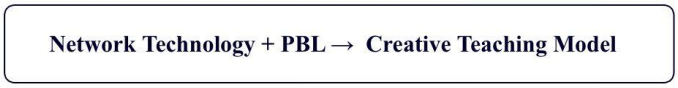

Figure 3. Creative Teaching Model

3.1 Advantages of The Integrate of Network Technology and Problem-Based Learning

Technology becomes an important part of PBL, network technology is used to better answer questions, enabling interaction, students play an important role in this innovative teaching model [40]. Advantages of the integrate of network technology and PBL as follows:

3.1.1 Learner-centered change

By shifting from a teacher-centered approach to one that is more student-centered, this approach will motivate students to learn, promote and develop their abilities [41]. With the use of PBL, students can engage in PBL through the use of network technology. Students can also use tools or devices that they feel they can use for learning [42].

In higher education, teachers need to create an PBL environment for students that is conducive to this innovative approach. University teachers need to use tools (network technology) such as questionnaires to gather feedback from students and to make timely adjustments to their teaching models to promote a more student-centered approach to teaching and learning.

3.1.2 Close to real-world challenges

PBL is all about problem-based connections to the real world so that a combination of network technology, teaching methods, and effective problem solving can be achieved. In Chinese higher education teaching, PBL is often not effectively integrated with network technologies and is sometimes not as effective as traditional teaching. Once the two are combined in an innovative teaching application, the time spent is reduced [43].

Technology has to some extent solved the problem of traditional teaching (single online or offline teaching) and has also increased the motivation of students to participate in the courses. China has established many educational platforms through technology, such as the National Public Service Platform for Smart Education, and the MOOC [44]. These are all educational products of the combination of online technology and PBL.

3.1.3 Enhancing collaboration

While PBL has gone some way to enhancing students' ability to work together in groups, the use of network technology has enhanced this collaboration. This collaboration is not only between students and students, but also between students and teachers [45]. The enhanced collaboration is also reflected in the integration of network technology with PBL to facilitate the exploration of learners' inquiry questions. Combining the advantages of the first two points, the learner-centered approach uses technology to solve real-world problems.

4 APPLICATION IN CHINESE HIGH EDUCATION

4.1 Application in Chinese High Education Form Academic Research

In the context of the integration of network technology and PBL in Chinese higher education, 100 academic studies by Chinese scholars were selected for this study. The results are shown in Table 1, with the most applications in computer education (28%), followed by language education (26%), medical (22%), and other studies in engineering education, psychology education, design education, vocational education and environmental education.

Table 1 The probability of the application the integration of network technology and PBL in Chinese higher education

Types of edcuation	Proportion
Engineering education	9%
Computer education	28%
Medical education	22%
Language education	26%
Psychology education	4%
Design education	4%
Vocation education	3%
Environmental education	4%

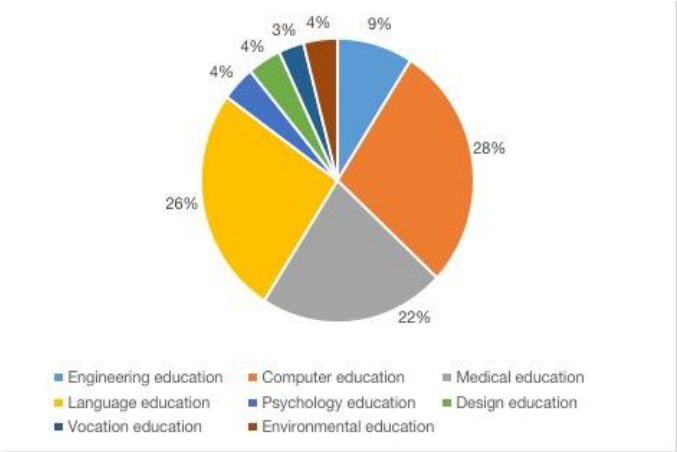

Figure 4. The probability of the application the integration of network technology and PBL in Chinese higher education

From Figure 4, it is clear that different types of education are being used to integrate network technology with PBL in Chinese higher education, mainly in computer education, medical education and language education, while other education needs to be developed in depth. The following are applications of network technology and PBL integration in computer education, medical education and language education.

4.2 Computer Education

In computer education, PBL is supported by network technology to help students conduct experiments that simulate real-world situations and practice, unlike traditional online teaching [46].

Many universities have developed PBL-based e-modules through the use of network technology, and these e-modules are more efficient than traditional learning. Some universities have used this to develop courses where students can role-play and create virtual realities, which have been developed to engage students. More and more universities are using these teaching tools in their computer education courses [47].

4.3 Medical Education

WeChat software combined with PBL can be applied to Chinese medicine courses, for example, where university teachers divide students into different groups of four to five. This is used to collect clinical data with the consent of the patient. This includes basic information about the patient. This data is sent to the WeChat group in the form of pictures, videos, etc. Students will be able to solve these problems in their groups based on this material. Each group will present based on group discussion and comment on their performance. Students can then share their experiences and improve their teaching. This teaching model can be applied to any course at any level. It was particularly effective during Covid-19 [48] [49].

In addition, the educational platform developed through the integration of network technology and PBL is very popular among medical teachers and students. This educational platform offers

several learning features. PBL allows you to store your medical organizational knowledge in the platform, use it for revision and pre-reading, and exchange messages with each other in the forum. The creation of online learning groups on the platform also fits in with the student-centered teaching model and allows for larger groups than traditional groups. The learning process includes recording and assessment. This integration also includes a wider range of teaching materials, including audio and visuals, which are more authentic than traditional teaching and increase student motivation [50].

4.4 Language Education

VR is almost entirely focused on education. VR technology can provide an immersive, interactive virtual learning environment for language courses. Several VR language software packages have been developed. Students can use VR devices for language practice. Students can be divided into groups to select environments for practice. With textual descriptions of selected points of interest in each scenario, students can then observe, describe, interpret and predicate their immersive real-life environment in the target language. These quizzes were not used for subsequent data analysis. The teacher should encourage the class to ask questions and provide feedback to each other during and after the presentation [51].

History courses can use VR technology in the teaching of the curriculum. The features of VR technology can improve the level and quality of teaching for teachers and the ability of students to learn independently. Firstly, VR technology can enrich the content of the history course by presenting it in a virtual and realistic environment. Students can learn about different historical cultures and even communicate with historical figures. This will be a new kind of learning. Students can work in groups to discuss and improve their learning efficiency. The teaching methods are modified based on student performance as feedback [52].

5 CONCLUSION

This paper describes the application of a creative teaching model combining PBL and network technology to computer education, medical education, and language education in higher education in China. Although this creative teaching model has been developed in China, there are some challenges. For example, some of the technology applications developed need to take into account the cost and immaturity of the technology. Many academic areas require more research to justify (currently the main areas are computer education, medical education, and language education). We believe that in the future, these issues will be addressed. There will be other new technologies combined with PBL that can be better applied to education for the benefit of humanity.

6 RECOMMENDATION

The creative teaching and learning model of PBL combined with network technology needs more enhancement in order to be widely promoted in Chinese higher education programmes.

Firstly, this creative teaching model has not been used for a long time and in many respects is not supported by academic research. Therefore, it needs government funding for higher

education, and there are areas where research needs to be focused, such as environmental education, design education, etc. Teachers and universities need to set up groups to design such creative teaching models [53].

Secondly, this is because of the problems with higher education in China. It requires strong government support and the cooperation of education stakeholders. For example, the relationship between the education sector, schools, teachers, students and their parents. The traditional Chinese education system is unlikely to adapt in a short period of time and this is an issue that needs to be considered [53].

Technology issues. The immaturity of technology can lead to problems with teaching models, which can affect student engagement and motivation. Technology also requires significant maintenance costs and many schools have abandoned the use of technology because of budgetary issues, as not every school can afford expensive applications [54].

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