

DEVELOPMENT OF PROJECT-BASED LEARNING INSTRUCTIONAL MODEL TO PROMOTE PROBLEM SOLVING ABILITY OF UNDERGRADUATE STUDENTS



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Abstract

The objectives of this research were 1) to examine the factors affecting problem solving ability of undergraduate students in Guangxi Province, 2) to develop project-based learning instructional model to promote problem solving ability of undergraduate students in Guangxi Normal University and 3) to study the results of project-based learning instructional model to promote problem solving ability of undergraduate students in Guangxi Normal University. Phases were carried out to answer research objectives 1, 2, 3. The population of Phase 1 were 150 former students and 3 lecturers of the Brand Clothing Design course in the 1st semester of the 2022 academic year from 3 colleges in Guangxi Province. The target group of Phase 2 were 3 specialists, and the sample group of Phase 3 were 21 students who enrolled in the Brand Clothing Design course in Guangxi Normal University. The research instruments were 1) a set of questionnaires for students, and interview for lecturers 2) a set of questionnaires for conformity instructional model, 3) lesson plans using project-based learning Instructional model, and 4) Scoring rubric form. Data were analyzed by percentage, frequency, mean, standard deviation.

The results revealed the following are the factors to promote problem solving ability of undergraduate students in Guangxi Province were internal and external factors. The former included Cognitive Skills, Psychology and attitude, while the latter involved teaching methods, materials, environment, and the project-based learning Instructional model to promote problem solving ability of undergraduate students in Guangxi Normal University include 5 components: (1) Principle and rationale, (2) Objectives, (3) Contents, (4) Method of teaching & materials and (5) Evaluation. The model was 100% conformed to utility, feasibility, propriety, and accuracy standards as assessed by 3 specialists. In summary, effective management of class size is crucial for optimizing the learning environment. If classes are too large, it becomes challenging for lecturers to attend to individual learning needs, while overly small classes may hinder healthy competition among student groups. Maintaining a relaxed and free classroom atmosphere is essential, and lecturers must adapt their approach based on the diverse communication styles of students. The course demands lecturers with social resources, practical experience, and a strong connection to actual projects. At the university level, fostering deeper partnerships with enterprises can provide students with hands-on opportunities, enhancing the overall teaching effectiveness and lecturer credibility.

Keywords: Project-Based Learning, Instructional Model, Problem-Solving Ability

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Introduction

Problem solving ability is one of the 21st-century core skills. Partnership For 21st Century Skills clearly stated that developing problem solving ability is an important part of education. "In modern societies, all of life is problem solving."(p.13, OECD, 2014) In order to build a high-quality talent training system, the Opinions of Chinese Ministry of Education on the Establishment of Colleges and Universities during the 13th Five-Year Plan Period divides Chinese colleges and universities into three types: research-oriented, application-oriented, and vocational skills-oriented from the perspective of personnel training. Application-oriented colleges and universities are generally local undergraduate colleges and universities, which mainly cultivate applied talents at the undergraduate level or above who are engaged in serving economic and social development. As a generally local undergraduate university, Guangxi Normal University is an application-oriented university with the goal of cultivating application-oriented talents. (Guangxi Normal University, 2021)

Applied talents should have strong practical ability and social ability. Practical ability is the ability to solve practical problems based on students' learning ability. Social ability refers to communication skills, teamwork ability and adaptability. (Ma, J., 2017) Brand Clothing Design course is a highly practical course for the undergraduate students majoring in Clothing and Accessories Design. The course simulates the product development process of a clothing enterprise, emphasizing that students solve actual problems through teamwork in actual situations. Product development in the course is a complex process related to many realistic factors such as economic, social, culture, technology, etc. Through the training of this course, students can improve their problem-solving ability communication & cooperation ability which could better achieve the goal of cultivating applied talents.

In recent years institutions of higher education have been trying to provide students with both hard skills, namely cognitive knowledge and professional skills (Vogler et al., 2018), and soft skills, such as problem-solving and teamwork (Casner-Lotto & Barrington, 2006). However, these skill related goals are not easy to be achieved as traditional learning has been playing a prevailing role where teachers are "the transmitter of the knowledge" while students act as "the receptor of the information" (Alorda, Suenaga, & Pons, 2011). As a result, it is difficult for students to fully engage in educational practices, which may lead to a superficial understanding of disciplinary knowledge. Thus, this might cause a gap between what students learn at the university and what they need in the workplace (as cited in Holmes, 2012). In many countries, voices from many employers are questioning that recent graduates' education and work competence are disconnected (Mtshali, 2005; Tilley, 2008 in Fan et al., 2015; Tan et al., 2018; Saifan et al., 2021; Jantzen, 2022). According to the feedback from graduate employment units, college students generally lack the ability to transform the professional knowledge and skills they have learned into professional practice to solve practical problems at work, and their communication skills with colleagues and leaders at work are also insufficient.

Gagné (1980) believed that "the central point of education is to teach people to think, to use their rational powers, to become better problem solvers". The students need to be provided with the opportunity to participate in real problem-solving and knowledge construction in authentic professional contexts. One attractive way to achieve this goal is through PBL. Theory and practical teaching are organically combined to fully explore students' creative potential and cultivate students' self-learning ability, observation ability, hands-on ability, scientific research and problem analysis ability, collaboration and mutual assistance ability, communication and comprehensive ability, etc.

Zhou (2010) and Yang (2010) found that PBL has a positive impact on the development of students' innovative ability, teamwork and communication skills through a survey of 60 projects in the university management information system department; Koh (2010) studied online PBL and found that PBL has a higher level of knowledge construction than asynchronous online discussions in non-project-based learning; Bilgin (2015) found that

compared with traditional teaching methods, PBL has a greater effect on college students' academic performance and self-efficacy. These advantages of PBL help to improve the problem-solving ability including both analytical aspect and dynamic aspects. Jalinus (2019) study about the course of welding practice carried out by implementation the PBL model enhance problem solving skill and skill competency of community college student. And found that the PBL model was implemented to the welding practical learning can improve student problem-solving abilities and also improve student competency skills that include knowledge, skills, work attitude and products.

As the rationale shown above, the author realizes the importance of studying "Development of Project-Based Learning Instructional Model to Promote Problem Solving Ability of Undergraduate Students".

Objectives

1. To examine the factors affecting problem solving ability of undergraduate students.
2. To develop project-based learning instructional model to promote problem solving ability of undergraduate students.
3. To study the results of project-based learning instructional model to promote problem solving ability of undergraduate students.

Material and Method

Literature review

Development of Instructional Model

Li (2001) defined instructional model as a teaching behavior paradigm that correctly reflects the objective laws of teaching and effectively guides teaching practice."

Yang (1999) defined instructional model as the expression of the simple assumption of the analogy that people make to the structure of teaching activities for specific cognitive purposes. The teaching model belongs to the category of teaching methods. It is a teaching method or a variety of teaching methods.

Gu (1998) defined instructional model in the "Dictionary of Education" as: a relatively stable and specific teaching activity structure that reflects the logical outline of a specific teaching theory and achieves a certain teaching task. It is hypothetical, approximate, operable and integrative.

Lai (1998) defined instructional model in "Modern Teaching Theory" a teaching mode refers to various types of teaching activities established in practice by designing and organizing teaching under the guidance of certain teaching ideas or theories. Basic structure, which is stably represented in a simplified form.

Xiong (1993) defined instructional model as the model of the teaching process, or a strategy system and teaching style related to the teaching procedure, that is, the whole teaching process formed according to the objective teaching law and certain teaching guiding ideology. A relatively stable teaching procedure and a strategy system for its implementation methods that must be followed.

Zhang (1988) defined instructional model as a theory of designing and organizing teaching formed in teaching practice, and this teaching theory is expressed in a simplified form.

Babanski (1988) defined instructional model as a comprehensive form based on the systematic combination of teaching forms and methods in teaching practice.

From the definition above, it can be concluded that instructional model refers a set of stable and universally applicable teaching model system that effectively integrate the teaching process, teaching content and teaching materials, guided by specific teaching objectives and based corresponding teaching theories.

Components of instructional model

There were many academic persons who defended about components of instructional model as follow:

Zhang (1988) contends that instructional model should consist of five components as follows.

1. Theme: the theme factor of the teaching mode refers to the teaching thought or theory on which the teaching mode is established;
2. Goals: any teaching mode points to a certain teaching goal and is created to accomplish a certain teaching goal;
3. Conditions or Means: conditional factors refer to the completion of certain teaching objectives, so as to make the teaching model effective;
4. Procedures: any teaching mode has a unique set of operating procedures, explaining in detail the logical steps of teaching, the tasks to be completed in each step, etc.
5. Evaluation: an important factor of the teaching mode, which includes the teaching mode's own evaluation methods and standards.

Qu (2005) suggests that instructional model should consist of five components as follows.

1. Theoretical basis: Any teaching mode is constructed under the guidance of certain teaching ideas, teaching theories and teaching concepts. It is a form of expression of certain teaching ideas, teaching theories and teaching ideas under certain conditions. The teaching theory or idea on which the teaching model is established determines the direction and uniqueness of the teaching model.

2. Teaching objective: refers to the teaching effect that the teaching mode should achieve. It is a pre-estimation of what effect the teaching activities in the teaching mode will have on the students. Any teaching mode is constructed to point to and realize certain teaching goals. Teaching objectives restrict the nature, function, characteristics and scope of teaching models.

3. Teaching procedure: refers to the logical steps of teaching activities in detail and the operation process of completing specific functions. Any kind of teaching mode is a specific and operational teaching idea or theory. Therefore, any teaching mode has a unique set of operating procedures and steps.

4. Auxiliary conditions: refers to the best combination or best plan of various conditions (teachers, students, teaching content, teaching media, time, space, psychological atmosphere, etc.) Strategies such as the principles, methods and techniques briefly put forward based on the teaching model. They are more specific instructions and requirements than theoretical foundations to guide the implementation of teaching procedures.

5. Evaluation standard: refers to the evaluation scale and evaluation method of the teaching mode. There are differences in various teaching modes in terms of theoretical basis, teaching objectives, teaching procedures, and auxiliary conditions. Therefore, the evaluation methods and standards are also different. Each teaching mode should generally have its own evaluation methods and standards suitable for its own characteristics.

Project-Based Learning

Project-based learning (PBL) is an innovative approach to learning that teaches a multitude of strategies critical for success in the twenty-first century. Over the past decades, the reform of teaching has focused on increasing the range of students' interests as well as their conceptual understanding of disciplinary content (DeCorte, Greer, & Verschaffel, 1996; National Council of Teacher of Mathematics, 1980; Schmidt, McKnight, & Raizen, 1997). One of the curricular and instructional models that addresses these two aspects is project-based learning (PBL). PBL is an inquiry-based instructional approach that offers one avenue to reform. It reflects a learner-centered environment that concentrates on students' use of disciplinary concepts, tools, experiences and technologies to answer questions and solve real-world problems (Krajcik & Blumenfeld, 2006; Markham, Larmer, & Ravitz, 2003) PBL was initially applied to K-12 education, and then gradually expanded to the field of higher

education, playing an important role in the mastery of knowledge and skills and ability training of college students. Although original work with inquiry processes in PBL has occurred in colleges and universities. Higher education has been much slower in adopting project-based learning compare to the progressive K–12 schools which have begun using PBL as an effective instructional model. (Lee, 2014)

Through Project-based Learning (PBL), students are provided with the opportunity to participate in real problem-solving and knowledge construction in authentic professional contexts. In recent years institutions of higher education have been trying to provide students with both hard skills, namely cognitive knowledge and professional skills (Vogler et al., 2018), and soft skills, such as problem-solving and teamwork (Casner-Lotto & Barrington, 2006). However, these skill related goals are not easy to be achieved as traditional learning has been playing a prevailing role where teachers are “the transmitter of the knowledge” while students act as “the receptor of the information” (Alorda, Suenaga, & Pons, 2011). As a result, it is difficult for students to fully engage in educational practices, which may lead to a superficial understanding of disciplinary knowledge. Besides, universities, and research universities, in particular, are more focused on the cultivation of students’ research skills rather than professional skills or transferable skills. Thus, this might cause a gap between what students learn at the university and what they need in the workplace (as cited in Holmes, 2012). Guo (2020) suggested that students are provided with the opportunity to participate in real problem-solving and knowledge construction in authentic professional contexts through PBL in order to change this situation.

Theory

PBL is related to constructivism theory; the central activities of PBL involve the transformation and construction of new knowledge (Oguz-Unver & Arabacioglu, 2014; Thomas, 2000). Krajcik (2006) stated that the roots of project-based learning extend back to the work John Dewey (1959). Dewey asserted the imperative of hands-on experience or learning by doing (Lam, 2008) and by forcing students to solve complex and open-ended problems, which can significantly improve the integration of knowledge (Lowenthal, 2006). Dewey argued that students will develop personal investment in the material if they engage in real, meaningful tasks and problems that emulate what experts do in real-world situations. The learning sciences researchers have refined and elaborated Dewey's original insight that active inquiry results in deeper understanding. New discoveries in the learning sciences have led to new ways of understanding how children learn (Bransford Brown & Cocking, 1999).

Four major learning sciences ideas was built as follow: (1) active construction; (2) situated learning; (3) social interactions, and (4) cognitive tools.

Project-based learning is an overall approach to the design of learning environments. Learning environments that are project-based have five key features (Blumenfeld et al., 1991; Krajcik, et al.1994; Krajcik, Czerniak, & Berger,2002):

Problem Solving Ability

Definition of Problem

Jonassen (2000) contends that there are only two critical attributes of a problem :

1. A problem is an unknown entity in some situation (the difference between a goal state and a current state).
2. Finding or solving for the unknown must have some social, cultural, or intellectual value. That is, someone believes that it is worth finding the unknown.

Newell (1972) stated that any problem has at least three components: givens, goal, and operations. Givens are the facts or pieces of information presented to describe the problem. Goal is the desired end state of the problem. Operations are the actions to be performed in reaching the desired goal.

Mayer and Wittrock (1996) described problems as ill-defined-well-defined and routine-nonroutine.

Jonassen (1997) distinguished well-structured from ill-structured problems and articulated differences in cognitive processing engaged by each. Well-structured problems

consist of a well-defined initial state (what is known), a known goal state (nature of the solution well defined), and a constrained set of logical operators (known procedure for solving). While Ill-structured problems, are the kinds of problems that are encountered more often in everyday and professional practice, so they are typically emergent. Their solutions are not predictable or convergent because they are not constrained by the content domains being studied in classrooms, Ill-structured problems may also require the integration of several content domains. Well-structured problems focus on correct, efficient solutions, while the ill structured problems focus more on decision articulation and argumentation. Jonassen summarized and classified the problems, and described the learning activities, input, success criteria, context, structural and abstractness of various problems.

Definition of Problem Solving

There were many academic persons who define the problem solving as follow:

Chi (1985) conducted that solving problems is a complex cognitive skill that characterizes one of the most intelligent human activities.

Wirth, J. & Klieme, E. (2003) conducted that problem-solving ability belongs to higher-order thinking ability, including analytical and dynamic aspects. Structuring, representing and integrating information requires analytical problem-solving skills. Dynamic problem solving includes aspects of self-regulated learning and the ability to adapt the problem-solving process to changing circumstances by continuously processing feedback information.

Anderson (1980, p. 257) defined problem solving as "any goal-directed sequence of cognitive operations". Those operations have two critical attributes. First, problem solving requires the mental representation of the situation in the world. That is, human problem solvers construct a mental representation (or mental model) of the problem, known as the problem space. (Newel, et al., 1972) Second, problem solving requires some activity-based manipulation of the problem space. Thinking is internalized activity (Jonassen, 2000). Conscious meaning making is engaged by activity, so there is a reciprocal regulatory feedback between knowledge and activity (Fishbein, Eckart, Lauver, van Leeuwen, & Langemeyer, 1990). Problem solving requires manipulation of the problem space, be it an internal mental representation or an external physical representation.

Gagné (1993) states that there are two kinds of problem-solving knowledge as following:

1. Declarative knowledge is knowing that something is the case. It is knowledge of facts, theories, events, and objects.

2. Procedural knowledge is knowing how to do something. It includes motor skills, cognitive skills, and cognitive strategies.

Declarative and procedural knowledge interact in a variety of ways during problem solving.

Jonassen (2000) contends that problem solving varies along at least three different dimensions: problem type, problem representation, and individual differences.

It was found that the research of problem-solving ability develops from simple well-structured problems solving to complex ill-structured problems solving which related to the real world. The problem-solving model has also evolved from a unified model to a hybrid model which incorporates creative thinking. The evaluation standard of problem-solving ability has changed from the result-oriented evaluation to the process evaluation that focuses more on dynamic problem-solving.

Material and Method

This research used mixed method of research. This research is divided into 3 phases.

Phase 1 was conducted to answer research objective 1: To examine the factors affecting problem solving ability of undergraduate students.

Table 1 Conduct research from Phase 1

Topics	Details
Research Process	Conformity assessment form for factors affecting the promotion of problem-solving ability of undergraduate students, including internal and external factors.
Research Objectives 1	To examine the factors affecting problem solving ability of undergraduate students.
Conduct research	Design the internal and external factors affecting problem solving ability of undergraduate students. Design the questionnaire for students and the interview for lectures outlines.
Target Group/ Key information	1) 150 former undergraduate students of Brand Clothing Design course in the 1 st semester on academic year 2022 from 3 colleges in Guangxi province. 2) 3 lectures teaching Brand Clothing Design course from 3 colleges in Guangxi province.
Instruments	1) Questionnaire with 12 items 2) Interview by 10 questions
Data Analysis	1) Descriptive Statistics i.e., Frequency, mean (μ) standard deviation (σ) for questionnaires 3) Content analysis for interview
Output	The result of the factors to promote problem solving ability of undergraduate students. The internal factors such as cognitive skills, psychology and physics, attitudes, the external factors such as teaching methods, materials and environment.

Phase 2 was conducted to answer research objective 2: To develop project-based learning instructional model to promote problem solving ability of undergraduate students.

Table 2 Conduct research from Phase 2

Topics	Details
Research Process	Develop project-based learning Instructional model in terms of accuracy standard, propriety standard, feasibility standard, and utility standard.
Research Objectives 2	To develop project-based learning instructional model to promote problem solving ability of undergraduate students
Conduct research	Study the component for development of project-based learning instructional model
Target Group/ Key information	By 3 experts through Item-Objective Congruence (IOC) according to the criteria.
Instruments	The handout for 3 experts through Item-Objective Congruence (IOC).
Data Analysis	Descriptive analysis i.e. frequency and percentage. The acceptable items must not be less than 100%.
Output	The suitability of project-based learning instructional model has been confirmed by experts and can be further implemented.

Phase 3 was conducted to answer research objective 3: To study the results of project-based learning instructional model to promote problem solving ability of undergraduate students.

Table 3 Conduct research from Phase 3

Topics	Details
Research process	1) Design lesson plan. 2) Design scoring rubric form.
Research objectives 2	To study the results of project-based learning instructional model to promote problem solving ability of undergraduate students
Conduct research	Designing instrument 1 (Lesson plan) Designing instrument 2 (Rubric evaluation form)
Target Group/ Key information	The 42 students who enroll in the Brand Clothing Design course at Guangxi Normal University in the 1st semester, the academic year 2024 from Section B by cluster random sampling.
Instruments	1. Lesson plan 2. Rubric evaluation form Congruence (IOC)
Data Analysis	Categorize students' performance according to rubric scoring criteria into their levels descriptor.
Output	Students' problem-solving ability are at a good level $\geq 80\%$.

Results and Discussion

Presents findings derived from the fieldwork procedures outlined previously, focusing on data collection crucial to this study. The objectives, outlined in Chapter I, serve three primary purposes:

Participants in this research were expected to possess a foundational understanding of project-based learning Instructional model to promote problem solving ability of undergraduate students. This knowledge was necessary for them to provide informed, analytical, and critical perspectives.

The Common data of the respondent in overall. (N=150)

The common data of the respondent in overall that the most gender is female, 66.00% of the total. The male respondents make up 34.00% of the total. The age was concentrated in 21-23 years old, accounting for 74.00% of the total, 18-20 years old accounting for 24.60%, and over 23 years old, accounting for only 1.40% of the total.

The result of questionnaire from students in overview. (N=150)

The indicated that internal factors affecting the problem-solving ability are found to be at a high level overall ($\mu = 4.22$). Considering each item individually, it was found that No.3 have the highest mean ($\mu = 4.31$), followed by No.2 and No.6 ($\mu = 4.25$), and the lowest mean is No.1 and No.5 ($\mu = 4.17$).

For external factors affecting the problem-solving ability, the overall level is found to be moderate ($\mu = 4.20$). Considering each item individually, it was found that No.3 has the highest mean ($\mu = 4.25$), followed by No.1 ($\mu = 4.21$), and the lowest mean is No.2 ($\mu = 4.01$).

The common data of the respondent in Guangxi Normal University, Guilin University of Technology and Guilin University of Electronic Technology.

The common data of the lecturers shows that the most common gender is Female, representing 100.00% of the respondents, while male lecturers make up 0.00% of the sample. In terms of teaching experience, 7-9 years accounted for 33.33% of the total, and over 9 years accounted for 66.67% of the total; In terms of the age of lecturers, the 36-49 age group accounted for 66.67%, and the 25-35 age group accounted for 33.33%. This shows that the interviewees are young and have relatively rich teaching experience, and they are the main personnel in front-line teaching positions in universities. Their views on the factors affecting problem solving ability of undergraduate students are more representative.

After interviews with 3 lecturers, the factors that affect the problem-solving ability of undergraduate students are summarized as follows:

Internal factors

Cognitive skills: The lecturers' knowledge system determines the completeness and scientifically of the construction of the basic subject framework in Brand Clothing Design course. The reasonable construction of the framework can help students choose the suitable knowledge points and theoretical tools to study in Brand Clothing Design course and promote problem solving ability. Lecturers' teaching skills are also very important to promote students' problem-solving ability. Scientific and effective teaching skills can better guide students. Lecturers can successfully transform their knowledge and experience into knowledge and skills that students can easily understand and actually operate. Therefore, teaching skills should complement the lecturers' professional knowledge, then lecturers can promote students' problem-solving abilities effectively. In an era of very fast knowledge iteration, the diversification and update speed of network knowledge far exceed that of traditional knowledge dissemination channels. Most of the means for students to obtain knowledge now come from the Internet. If teachers cannot maintain the advancement of knowledge and skills and cannot help students solve new problems with advanced methods and means, it will be difficult to achieve good communication and interaction with students in the classroom and help students conduct in-depth learning and discussion.

Psychology and physical: Lecturers' core values and personal qualities affect students' views and judgments on things. Lecturers guide students to reflect on the world, imagine life

and look forward to the future, so that students have a sense of social responsibility and moral beliefs, allowing students to pay more profound attention to real problems and seek ethical solutions to problems. Lecturers' personality and growth background may have a certain impact on the teaching implementation process and indirectly affect students' problem-solving abilities.

Attitude: Lecturers' spiritual motivation for knowledge and belief in education will be passed on to students, so that students can continue to thirst for knowledge and learn for life, and continuously promote their problem-solving abilities in the process of growth. Throughout the teaching process, the lecturers' attitude can play a positive role in the course, but it does not play a decisive role. Because college students are not like younger primary and secondary school students, they have relatively independent self-learning ability and ability to understand problems under the guidance of lecturers.

External factors

Teaching methods: The questions raised by the lecturers are of moderate difficulty, allowing students to study with questions; listing more representative typical cases; teaching students some self-study methods, such as some learning resources, investigation methods, analysis and synthesis abilities, etc. Assessment methods should be more diversified, with equal emphasis on process evaluation and result evaluation. Incentive measures can be carried up to promote students' motivation for learning, such as giving students more opportunities to express their opinions; conducting more practical training, for example, participating in lecturers' projects or corporate projects, assuming the role of designers through the project system; cooperating with clothing companies, giving students the opportunity to participate in actual market projects, inviting corporate personnel to evaluate students' works; and participate in professional competitions etc.

The project-based learning is a good choice for "Brand Clothing Design" course because this course is offered at the senior level after completing the basic courses. Students should have a relatively comprehensive understanding of basic design processes, techniques and materials. Learning and carrying out project-based learning require such a prerequisite. Students combine theory and practice through actual or virtual projects, and through team cooperation, students can promote their ability to solve practical problems. There are something should be concerned: first, the project chosen by the lecturer must be closely related to society and have certain practical significance, so that students will be motivated to do it; secondly, during the training process of this project, students can obtain inspiration and implementation paths by imitating previous or similar cases. It is an effective learning method for students to find their own imitation objects and reference standards in the course. Therefore, the project chosen by the teacher must be more realistic and the entry point must be clear and accurate.

Materials: In addition to professional textbooks and reference books, lecturers should lead students to a more diverse and richer world of knowledge. Lecturers can share more of what they seen and heard, such as introducing students to brands, designers, websites, books and videos that can bring inspiration that they usually don't know, etc. Lecturers should expand the content of the course, not just limited to knowledge and information about brand clothing design, but also other related materials, such as documentaries, biographies, movies, etc., which can be used as some materials for the courses to enrich students' knowledge, expand their vision and improve their aesthetics.

Environment: The hardware environment is not very important in the course because students may need to complete tasks outside the classroom through discussions and social practice instead of just sitting in classroom. A class size of 20-30 students is more appropriate.

If the class size is too large, the lecturers will not be able to consider the learning status of all learners; if the class size is too small, there will be fewer groups, which will not create a healthy competitive relationship between the groups for better promote learning. The classroom atmosphere should be appropriately relaxed and free. Lecturers also have to control the classroom atmosphere. Students in some classes are livelier and outgoing which have a

strong desire to communicate and willing to communicate, so the lecturer needs to make them calmer and more rational; students in some classes are more reserved, relatively introverted, and not good at communication, so lecturers need to activate the classroom atmosphere and mobilize students' sense of competition. From the lecturers' perspective, this course requires lecturers to have social resources and social concepts, as well as experience in participating in actual projects, which is very important for the teaching effect and the lecturers convincing power in the minds of students. From the university level, the university should create more in-depth links with relevant enterprises, build a platform for in-depth cooperation between universities and enterprises, which can provide students with opportunities to personally participate in real enterprise work processes.

References

- Alorda, B., Suenaga, K., & Pons, P. (2011). Design and evaluation of a microprocessor course combining three cooperative methods: SDLA, PjBL and CnBL. *Computers & Education*, 57(3), 1876–1884.
- Bilgin, İ., Karakuyu, Y., & Ay, Y. (2015). The effects of project based learning on undergraduate students' achievement and Self-Efficacy beliefs towards science teaching. *Eurasia Journal of Mathematics, Science and Technology Education*, 11(3).
- Bransford, J., & Stein, B.S.(1984/1993). *The IDEAL problem solver: A guide for improving thinking, learning, and creativity*. New York:W.H.Freeman.
- Casner-Lotto, J., & Barrington, L. (2006). *Are they really ready to work? Employers' perspectives on the basic knowledge and applied skills of new entrants to the 21st century US workforce*. Partnership for 21st Century Skills. 1 Massachusetts Avenue NW Suite 700, Washington, DC 20001.
- Chi, M.H., Glaser, R., Farr, M.J.(1988). *The Nature of Expertise*. Hillsdale, NJ: Lawrence Erlbaum.
- Gagné, E.D., Yekovich, C.W., Yekovich, F.R.(1993) *The Cognitive Psychology of School Learning*. New York: Harper Collins
- Gagné, R.M. (1980). *The conditions of learning*. New York: Holt, Rinehart, & Winston.
- Guangxi Normal University, 2021. *Guangxi Normal University's Guiding Opinions on the Revision (Formulation) of Undergraduate Professional Talent Training Programs*, 2-4.
- Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, 102, 101586.
- Gu, M.Y.(1998). *Educational Dictionary*. Shanghai: Shanghai Education Press, 717.
- Jalinus, N., Syahril, S., & Nabawi, R. A. (2019). A comparison of the problem-solving skills of students in PjBL versus CPjBL model: An experimental study. *Journal of Technical Education and Training*, 11(1).
- Koh, J. H. L., Herring, S. C., & Hew, K. F. (2010). Project-based learning and student knowledge construction during asynchronous online discussion. *Internet and Higher Education*, 13(4), 284–291.
- Lee, J. S., Blackwell, S., Drake, J., & Moran, K. A. (2014). Taking a leap of faith: Redefining teaching and learning in higher education through project-based learning. *Interdisciplinary Journal of Problem-Based Learning*, 8(2), 2.
- Loyens, S. M. M., Van Meerten, J. E., Schaap, L., & Wijnia, L. (2023). Situating Higher-Order, Critical, and Critical-Analytic Thinking in Problem- and Project-Based Learning Environments: A Systematic review. *Educational Psychology Review*, 35(2).
- Ma, J. (2017) A Discussion on the Cultivation Objectives of Applied Talents. *China Adult Education*, 8,78-80.
- Mayer, R.E., & Wittrock, M.C. (1996) Problem-solving transfer. In D.C. Berliner & R.C. Calfee (Eds.), *Handbook of educational psychology* (pp. 47-62). New York:Macmillan
- Treffinger, D. J. (1995). Creative Problem Solving: Overview and educational implications. *Educational Psychology Review*, 7(3), 301–312.
- Vogler, J. S., Thompson, P., Davis, D. W., Mayfield, B. E., Finley, P. M., & Yasseri, D. (2017). The hard work of soft skills: augmenting the project-based learning experience with interdisciplinary teamwork. *Instructional Science*, 46(3), 457–488.
- Wirth, J., & Klieme, E. (2003). Computer-based assessment of problem-solving competence. *Assessment in Education: Principles, Policy & Practice*, 10(3).
- Yang, H., & Cheng, H. (2010). Creativity of student information system projects: From the perspective of network embeddedness. *Computers & Education*, 54(1), 209–221.
- Yeung, M. M., Yuen, J. W., Chen, J. M. T., & Lam, K. K. (2023). The efficacy of team-based learning in developing the generic capability of problem-solving ability and critical thinking skills in nursing education: A systematic review. *Nurse Education Today*, 122, 105704.
- Yuan, W. X. (2010). On the Creative Problem-Solving Model Research. *Studies in Foreign Education*, 37(7), 6-11.
- Zhang, X.C., Chen, M.K., Wang, R.M. (2022). Research on the Development Trend of OECD Adult Problem Solving Competency Assessment, *Adult Education*, 228(9), 10-16.