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RESEARCH ARTICLE

Development of Project-Based Learning (PBL) in Cloud Education Model to Enhance the Application Ability and Computational Thinking for Undergraduate Students

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ABSTRACT

This research investigated the Development of Project-Based Learning (PBL) in Cloud Education Model to Enhance the Application Ability and Computational Thinking Undergraduate Students with the core objectives, to study the needs of students and teachers towards the teaching approach based on Project-Based Learning (PBL) in Cloud Education in Word Software Application, to design Project-Based Learning (PBL) in Cloud Education model 3, and to compare Word Software Application ability and computational thinking between students who learn in Project-Based Learning (PBL) in Cloud Education model and students who learn in Traditional Teaching Method. Qualitative and Quantitative both methods were used in the current study. As the research population, from a pool of 165 students, a total of 100 students majoring in accounting from the 2022 cohort of Nanning University was randomly selected along with five lecturers from the "College Computer Foundation" course. Questionnaire was used for collecting data from students while a focus group interview was adopted for collecting in-depth data from focus group teachers. The result of study brought to surface that students expect a classroom atmosphere with higher participation, more active classroom, and stronger interactivity thereby promoting course learning and achieving course goals. The revised teaching model emphasizes active learning, practical application, and the cultivation of computational thinking, aiming to provide a richer and more effective educational experience. The revision process involves multiple steps such as project design, group task allocation, plan formulation, exploration and cooperation, work production, achievement exchange, summary and evaluation, and the use of cloud education platforms to support teaching and learning activities. This process fully reflects the importance of continuously optimizing and improving educational models to adapt to the constantly changing learning environment and needs.

INTRODUCTION

The origin of project-based learning can be traced back to the early 20th century, when John Dewey and other educators emphasized the importance of experiential learning and interdisciplinary knowledge integration. However, PBL became popular in the 1960s and 1970s, which is a response to the limitations of traditional lecture teaching (Kokotsaki et al., 2010).

Kokotsaki et al. (2016) presented a detailed review on Project-based learning, highlighting that it is a student-centered form of teaching learning strategy in which students actively participate characterized by students' constructive inquiries, independence, , goal-setting, teamwork, interactive, communication and replication within real-world practices. Contemporary digital technology, high quality group processes, teachers' capability to successfully scaffold students' learning and facilitate and support, the poise between didactic teaching with comprehensive inquiry methods and aligned assessment are identified as enabling factors in the successful implementation of PBL.

Boss and Krauss (2016) stated that in the past decades, PBL has been highly accepted and promoted by educators around the world as a mean to endorse in-depth learning, expand student participation and equip students for attainment in the 21st century. As well as many educators believe that PBL is an effective way in developing problem-solving, collaboration, communication skills, critical thinking, and creativity skills, which are critical to the success of today's rapidly changing world.

PBL can be design in various format, i.e. short-term projects of few days to long-term projects for weeks or even the whole semester. Some projects are designed to solve specific problems or challenges, while others are more open, allowing students to explore topics of interest in depth (Lydon et al., 2015).

The significance of PBL is of high concern for the development of students learning abilities in the current era of technology, so keeping in view this the current stud is design to investigate the Development of Project-Based Learning (PBL) in Cloud Education Model to Enhance the Application Ability and Computational Thinking for Undergraduate Students

Objectives of the study

The study was based on following objectives:

- To identify the needs of students and teachers towards the teaching approach based on Project Based Learning (PBL) in Cloud Education in Word software application.
- To design Project-Based Learning (PBL) in Cloud Education model.
- To compare Word software application ability and computational thinking between students who learn in Project-Based Learning (PBL) in Cloud Education model and students who learn in Traditional Teaching Method.

Research questions

The following research questions were followed for conducting the study:

- What are the needs of students and teachers towards the teaching approach based on Project-based Learning in Cloud Education in the application teaching of Word software?
- How to create an effective Project-based Learning teaching model in Cloud Education?
- How to find the effectiveness of the Project-based Learning in Cloud Education model to improve Word software application ability and computational thinking in students?

LITERATURE REVIEW

Project-based Learning

Zhao and Wang (2022) described Project-based learning as an innovative teaching methodology that prioritize students in the learning process. It involves the construction of new knowledge on the utilization of existing knowledge within project execution and enabling problem-solving ability among students.

Similarly, Jin (2019) asserted that Project-based learning is a teaching method that consider students as central part and uses existing knowledge. Current research emphasized the significance of Project-based learning in adopting critical skills vital for this digital age. There is found a high impact of Project-based learning on students' problem-solving abilities in a Cloud Education setting in a way that PBL improved students' critical and analytical thinking abilities, empowering them to efficiently handle complex real life situations within the setting of project (de Jong et al., 2014).

Hmelo-Silver (2004) mentioned that there are many kinds of views about it, such as project-based learning. Li (2001) believes that PBL takes the basic concepts and principles of the subject to which the problem is being explored as the core of the exploration. Liu and Zhong (2002) emphasizes learner-centered learning through group collaboration. Mohamad Hanefar et al. (2021) studied a comparison between Project-based learning and traditional methods and their study establish that Project-based learning meaningfully developed students' communication and problem solving skills as we as team work collaboration proficiencies.

Origin of PBL

Zhao and Wang (2018) stated that PBL origin is Europe and originated from the teaching method of design created by Dewey. BIE (2008) put forward project-based learning completely for the first time and carried it out widely in major hospitals. Savin-Baden and Major (2013) related PBL with the cultivation of students' knowledge and skills, related abilities, literacy and other aspects.

Status of PBL

Verma et al. (2011) highlighted that students can work in groups and solve problems, thus improving their learning ability. Dolmans et al. (2016) mentioned that the PBL teaching model has also been widely used, such as the University of Maastricht in the Netherlands and the University of Leuven in Belgium.

NCERC (2022) pointed out that in India, many institutions of higher learning emphasize the practice of project-based learning tasks in curriculum teaching. Baser et al. (2017) stated that technology and cooperation skills and enable them to integrate technology into scientific practice. Deng (2019) mentioned that in general, in China today, with the application of PBL teaching mode by front-line teachers.

Characteristics of PBL

WECRI (2019) asserted that PBL signifies the learning capability and advance ability in practical exploration, and accomplished the goal of promoting digital learning cognizance and motivation.

Boelens et al. (2015) mentioned that the teaching model and stimulate the core issue of students' autonomous learning. Wang et al. (2018) highlighted PBL encourage students' capacity to explore, investigate and resolve practical problems independently.

Similarly, the theory of Bandura proposes that students can be engaged in real-world projects, they can improve self-efficacy by effective application knowledge and skills, leads to transforming them into competent "digital citizens."

Application and computational thinking ability

Schartmüller et al. (2019) describes that the ability of software application states to organizations' or individuals' ability in using efficiently software systems.

The computational thinking is presented by Wing (2006) as an evolving research theme in education and in education. It has bring in significant consideration and has developed as a pivotal point in the digital landscape. Li et al. (2015) describe computational thinking as "abstract automation," highlighting the significance of choosing the right concepts and computers to attain efficient problem-solving.

Papadakis et al. (2021) studied the integration of computational thinking in a cloud education model and its effectiveness on students' problem-solving abilities. The study resulted that cloud-based computational thinking strategies predominantly enhanced students' logical reasoning and algorithmic skills, enabling their shift into capable problem-solvers in various fields.

In current social living environment, to keep stride with the speedy expansion of the information society stresses a cognizant effort to reinforce learning and nurture qualified "digital citizens" (Fraillon et al. 2014).

Conceptual framework of the research study

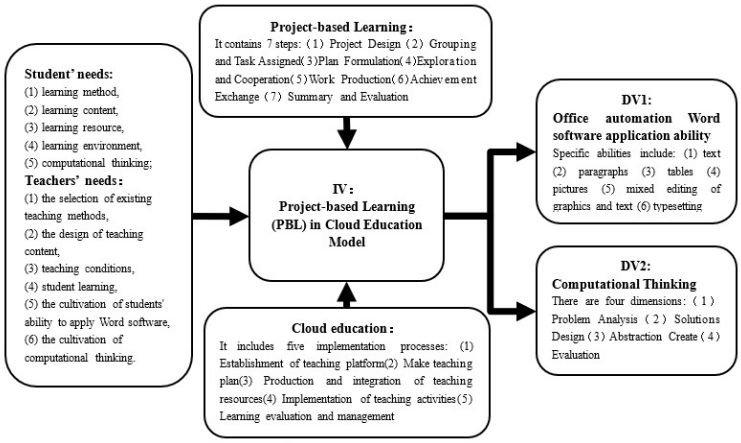

Figure 1: Research framework

RESEARCH METHODOLOGY

Research design

Qualitative and Quantitative both methods were used in the current study. A mixed method approach is widely used by the researchers in order to triangulate the results of the study.

Population and sample

As the research population, from a pool of 165 students, a total of 100 students majoring in accounting from the 2022 cohort of Nanning University was randomly selected along with five lecturers from the "College Computer Foundation" course.

Research instruments

For collection of relevant data two research tools were used. Five-point Likert scale questionnaire for studying student needs and focus group interviews for studying teacher needs. The researcher designed the questionnaire and interview outline based on the research questions and objectives, and invited five experts to conduct IOC testing for the purpose of piloting the questionnaire and interview content, respectively, to identify issues or measurement dimensions with internal consistency, improving the validity of the questionnaire. For students, the researcher distributed the questionnaire to 100 students through Wenjuanxing platform, and the questionnaire was anonymous to ensure that students can provide more authentic information for this study. For teachers, the researcher invited five teachers to conduct focus group interviews according to the interview outline, recorded the responses of each interviewee.

DATA ANALYSIS AND RESULTS

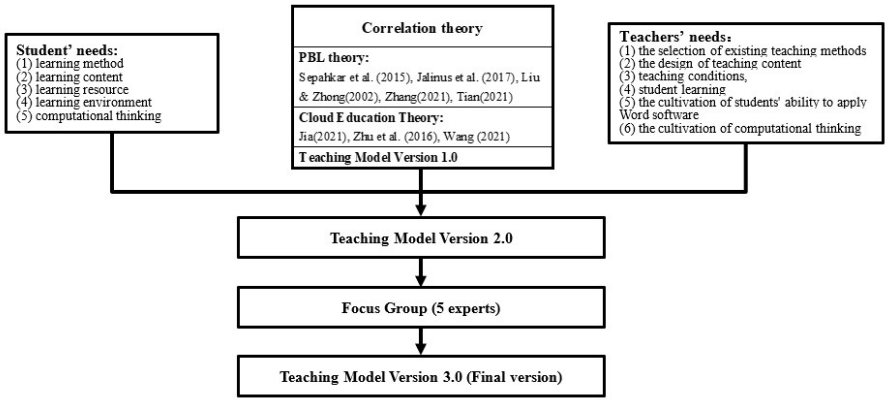

Figure 2: Revision flowchart of teaching model

The quantitative data was analyzed through mean sore and standard deviation by using latest version of SPSS. The result of study is categorized in the following three sections.

Section 1, discusses the needs of students and teachers for project-based learning teaching models in cloud education in Word software applications. Section 2, discusses the results of the Project-Based Learning (PBL) in Cloud Education model. While, Section 3, presents the results of the students' Word software application ability and computational thinking between students who learn in Project-Based Learning (PBL) in Cloud Education model and students who learn in Traditional Teaching Method. The flow hart of data analysis is mentioned in the figure 2.

The researchers improved the teaching model by combining student needs, teacher needs, and relevant theories; Then invite 5 experts to focus group discussions on the improved version 2.0 teaching model; Finally, based on the results of the focus group discussion, the teaching model was revised again to form the final version (version 3.0) of the teaching model, which was incorporated into the teaching experiment.

The results of the Project-Based Learning (PBL) in cloud education model

This section summarizes the improvement and revision of the Project-Based Learning (PBL) model in cloud education to determine the final version of the teaching model and apply it to the teaching activities of the experimental group. The specific revised content includes:

Revision of version 1.0 teaching model:

Researchers have comprehensively considered and combined the needs of students and teachers, as well as relevant educational theories, to revise version 1.0 of the teaching model. The main work contents of this revision include:

- Optimize learning methods, emphasize learning interaction and cooperation, to stimulate students' active learning interest.
- Enrich the learning content, introduce practical cases and real projects, and focus on practical social applications and daily life related content.
- Improve the learning environment, encourage active participation in learning and classroom interaction, and enhance the learning atmosphere.
- Cultivate computational thinking, introduce project-driven learning and continuous feedback and evaluation strategies.

Revision of version 2.0 teaching model:

After obtaining version 2.0 of the teaching model, the researchers invited 5 experts for a focus group discussion to evaluate the rationality of version 2.0 of the teaching model. Most experts believe that the design of teacher and student activities is reasonable, and the use of cloud platforms is also reasonable. However, they also provide some useful suggestions, such as:

- Provide more guidance during the grouping and task allocation stages to ensure team balance.
- Provide more specific guidance during the work development phase to ensure project quality.
- Guide students to engage in deeper reflection and experience summary during the summary and evaluation stage, and provide more specific self-evaluation guidance.

From the data results in Table1, it can be seen that students' computational thinking needs mean score is 4.39, and SD is 0.49, and for each question the mean values are 4.37 to 4.42, and SD were 0.55 to 0.60, all of which are greater than 4.

The highest mean score among them is question 5, which indicates that students hope to exercise and improve their basic computational thinking abilities by adopting new teaching methods.

Table 1: Results of the students' word software application ability

Question	N	Mean	Std. Deviation
1. In the process of learning Word software, you hope to exercise or improve your computational thinking ability.	100	4.38	0.57
2. In the process of learning Word software, when facing problems, you hope to have the ability to analyze problems, decompose problems, and identify key elements of the problem.	100	4.39	0.6
3. In the process of learning Word software, when faced with problems, you hope to be able to integrate scattered knowledge points, thus possessing the ability to create abstractions.	100	4.37	0.6
4. In the process of learning Word software, when facing problems, you hope to have the ability to evaluate the effectiveness of solutions.	100	4.41	0.55
5. In the process of learning Word software, when facing problems, you hope to have the ability to iteratively optimize solution design.	100	4.42	0.59
Students' computational thinking needs	100	4.39	0.49

Mean and Standard Deviation of students' computational thinking needs (N=100)

DISCUSSION AND CONCLUSION

In summary, this section describes how to gradually improve the teaching model by combining student needs, teacher needs, and expert advice to promote the application of Project-Based Learning (PBL) in cloud education. The revised teaching model emphasizes active learning, practical application, and the cultivation of computational thinking, aiming to provide a richer and more effective educational experience. The revision process involves multiple steps such as project design, group task allocation, plan formulation, exploration and cooperation, work production, achievement exchange, summary and evaluation, and the use of cloud education platforms to support teaching and learning activities. This process fully reflects the importance of continuously optimizing and improving educational models to adapt to the constantly changing learning environment and needs.

The "Project Based Learning (PBL) in Cloud Education" educational model is a new teaching model proposed based on Sepahkar et al. (2015), Jalinus et al. (2017), Liu and Zhong (2002), Zhang (2021), and Tian (2021)'s PBL model, combined with the cloud education theories of (Jia, 2021), Zhu et al. (2016), and Wang (2021). After the first revision of the teaching model, which combined the needs of students, teachers, and relevant theories, five experts were invited for focus group discussions to form the final version of the teaching model, which was incorporated into the teaching of the experimental group.

Features: Through the study of this model, the following characteristics of this model can be highlighted:

- This model integrates elements of project-based learning and cloud education, emphasizing students' practical participation and cooperation, which helps to cultivate practical problem-solving abilities.
- The model emphasizes practical application, applying real projects to teaching, and encouraging students to apply knowledge and skills to real-world problems.
- Cross platform support, utilizing two cloud education platforms (such as Chaoxing Cloud Platform and Dingtalk Cloud Platform), facilitates the integration and use of diverse learning resources, highlighting personalized learning. Students can choose diverse online resources based on their interests and learning speed.
- This model focuses on the active participation and interaction of students and provides a good interactive environment. Teachers play the role of guides and supporters in this model, providing feedback and problem-solving to students, and encouraging them to collaborate and establish a positive learning atmosphere. The cooperation and interaction between students also help to solve problems together, while also promoting knowledge transfer and skill development.

Challenge

However, this model also faces some challenges. For example, it is necessary to ensure that teachers have sufficient educational technology capabilities and diversified teaching resources to support the effective implementation of this model. In addition, the process of evaluating students' computational thinking requires tracking their learning process performance and presenting the final results, which may require more time and effort.

Recommendations

The following recommendations are made in the light of findings of the study:

Suggestions from practitioners

Teacher training and development: As this model integrates elements of project-based learning and cloud education, it requires practitioners to have a certain level of PBL experience, educational technology skills, team collaboration and management skills. Therefore, it is recommended to provide continuous and relevant training and development opportunities for practitioners.

Curriculum design and resource support: In this study, due to the involvement of real projects, educational institutions or practitioners can actively select real project cases that meet the requirements of this study through school enterprise cooperation projects or open source social projects. At the same time, it also includes corresponding resources, online courses, multimedia resources, etc.

Student oriented and personalized learning: Due to the inclusion of PBL in this model, it is destined to be a student-oriented teaching model. Therefore, teachers need to have the ability to listen to students' needs and feedback, and be able to support their learning in a personalized way. This may require more time and energy to interact with students, which also requires teachers to have a certain level of dedication.

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