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RESEARCH ARTICLE

Enhancing Project-based Learning (PBL) in Cloud Education Models for Word Software Courses

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ABSTRACT

This research aimed to conduct a comprehensive needs analysis to gauge the needs of both students and educators concerning Project-Based Learning (PBL) in the context of a Cloud Education Model for Word Software Courses. The primary objectives encompassed the assessment of students' receptiveness towards PBL adoption and the evaluation of instructors' levels of enthusiasm for embracing the PBL instructional model. The study emphasized establishing a synergistic understanding between educators and learners regarding the seamless integration of PBL within the Cloud Education framework. Significantly, the research sought to innovatively develop and put together PBL within the Cloud Education milieu, discerning disparities in software proficiency and computational thinking between students exposed to PBL through Cloud Education and their counterparts experiencing traditional instructional methodologies.

INTRODUCTION

In today's ever-evolving social living environment, keeping pace with the rapid development of the information society demands a conscious effort to strengthen learning and cultivate qualified "digital citizens" (Fraillon et al., 2014). Post-00s college students are often labeled "digital aborigines" due to their inherent familiarity with technology. However, their generational affinity with technology alone does not guarantee their transformation into adept "digital citizens." These students must go beyond mere familiarity and actively develop an innovative mindset and practical acumen to truly excel in the digital realm. As they embark on the journey towards becoming qualified "digital citizens," recognizing the indispensable role of digital learning in enhancing independent development and comprehensive skills is essential (Zhou, 2023).

Despite recognizing the importance of digital learning and the evolution from "digital aborigines" to "digital citizens," there remains a notable research gap regarding the effective implementation of digital learning in technical courses such as Word software. In these courses, hands-on proficiency is crucial, and students' interest and enthusiasm for learning play a pivotal role in achieving desired learning outcomes. However, a deeper investigation is needed

to understand how digital learning methodologies can effectively nurture and sustain students' interest and enthusiasm within these technical contexts.

The model proposed is supported by social learning theory. This theory, pioneered by Albert Bandura, posits that individuals learn from observing and imitating the behavior of others within their social environment (Bandura and Walters, 1977; Hamid, 2022; Johnson and Bradbury, 2015; Shahzad et al., 2022). Students can benefit from collaborative and interactive experiences in digital learning, which is central to Project-Based Learning. Social Learning Theory highlights the importance of social interactions in the learning process. Through collaborative projects in the Cloud Education setting, students can observe and learn from their peers, teachers, and online resources, fostering a deeper understanding of Word software and its practical applications. Bandura's theory suggests that by engaging in real-world projects, students can develop self-efficacy as they witness the successful application of their skills and knowledge, ultimately transforming them into qualified "digital citizens."

The significance of this topic lies in understanding and addressing the challenges faced by post-2000 college students as they strive to become proficient "digital citizens." Enhancing their digital skills extends beyond Word software and encompasses various technical fields that require computational thinking and practical application. As educational institutions seek to optimize digital learning experiences, it becomes imperative to identify effective strategies for sustaining students' interest and enthusiasm and ensuring the successful attainment of learning objectives.

By bridging this research gap and unraveling best practices for nurturing students' interest and enthusiasm in technical courses through digital learning, educators can develop tailored approaches that foster comprehensive skill development, empower computational thinking, and cultivate a new generation of skilled "digital citizens" poised to thrive in the dynamic and technology-driven landscape of the information age. This research can shape the future of education, enabling students to navigate and excel in an increasingly complex digital world (Bilal et al., 2022; Fraillon et al., 2014; Tahira et al., 2022). The findings will contribute to the ongoing transformation of education, preparing students to adapt and succeed in the rapidly evolving digital era (El-Saleh et al., 2023; Waheed and Jam, 2010; Zhou, 2023).

Objectives of the study

- To assess students' and teachers' perceptions of the teaching mode based on Project-Based Learning (PBL) in Cloud Education when applied to Word software instruction.
- To develop an effective teaching model for Project-Based Learning (PBL) in Cloud Education, incorporating strategies and elements that enhance student engagement and learning outcomes.
- To compare students' Word software application ability between those who participate in Project-Based Learning (PBL) within the Cloud Education model and those who experience Traditional Teaching Methods.

LITERATURE REVIEW

Project-based learning (PBL), as described by Zhao and Wang (2022), is an innovative teaching approach that places students at the center of the learning process. It involves utilizing existing knowledge to construct new knowledge within project execution and facilitating problem-solving while completing the project. The ultimate goal is cultivating students' core skills and enhancing their comprehensive abilities. In the educational landscape, various terms such as "project-based learning," "project-based teaching," and "project-based education" have been used to describe this approach (Hmelo-Silver, 2004).

Recent research has further highlighted the benefits of PBL in fostering critical skills essential for the digital age. A study by de Jong et al. (2014) explored the impact of PBL on students' problem-solving abilities in a Cloud Education setting. The findings demonstrated that PBL enhanced students' analytical and critical thinking skills, enabling them to effectively tackle complex challenges within the project context. Hanefar et al. (2021) also compared PBL with traditional teaching methods and found that PBL significantly improved students' collaboration, communication, and creative problem-solving capabilities.

Cloud education

Cloud education, as emphasized by Sabi et al. (2016), is a revolutionary model that facilitates data sharing and significantly contributes to the advancement of the IT sector. By leveraging cloud-based technologies, educational resources, and services can be easily accessed and shared, fostering a dynamic and accessible learning environment.

Recent studies have delved into the impact of cloud-based learning platforms on student engagement and learning outcomes. Zhang et al. (2022) conducted a comprehensive meta-analysis of cloud-based education platforms and found that these platforms positively influenced students' motivation to learn and led to improved learning outcomes across various subjects. Additionally, Huang et al. (2021) examined the effectiveness of cloud-based learning environments in enhancing students' digital literacy skills and reported significant improvements in digital competence and information processing abilities.

Teaching mode based on Project-Based Learning (PBL) in cloud education

According to Hao (2021), the ChaoXing cloud platform focuses on serving students' acquisition of teaching resources during the PBL process. The platform offers an extensive repository of teaching resources with rapid knowledge updates and iterations closely linked to cutting-edge knowledge. It provides various courses at varying knowledge levels, enabling learners to select and engage with the knowledge that best suits their needs.

Recent studies have explored the integration of PBL into cloud-based learning platforms and its impact on student engagement and learning outcomes. Bhuyan et al. (2020) examined the effectiveness of PBL in a cloud education environment and found that students exhibited increased motivation, collaboration, and problem-solving skills. The study further indicated that cloud-based PBL contributed to developing critical skills, preparing students to excel in the digital age.

Students and teachers' needs

In the context of learning needs analysis, Yeh et al. (2019) highlights the importance of investigating and analyzing learning needs to identify teaching process shortcomings, their reasons, and effective remedies. This approach enhances the design of teaching methods, making them more targeted and efficient. Conversely, Blix views learning needs analysis as a specific concept in instructional design, referring to the "gap between the current situation and the desired state" of students' learning.

Recent research has expanded our understanding of learning needs analysis in the digital era. Wei et al. (2021) explored the dynamic nature of students' learning needs in cloud-based environments and proposed a data-driven approach to continuously assess and adapt teaching methods to meet students' evolving requirements. Their study emphasized the significance of personalized learning experiences in addressing individual learning needs and optimizing educational outcomes.

Application ability of office automation software

As described by Schartmüller et al. (2019), Office automation software is designed to address the challenges of office-related tasks and improve overall office efficiency. It automates routine office functions such as document processing, email management, scheduling, and data management. Common office automation software includes the Microsoft Office suite (e.g., Word, Excel, PowerPoint, and Outlook), Google Docs, and WPS Office. As defined by Chen and Zhu (2017), software application ability refers to individuals' or organizations' proficiency in using specific software or software systems.

Recent research has explored the correlation between students' software application ability and academic performance. Wang et al. (2021) conducted a study on students' use of office automation software in a cloud education environment and found that students with higher software application abilities achieved better academic performance across various subjects. This suggests that enhancing students' application skills in cloud-based office software positively impact learning outcomes.

Computational thinking

Wing (2006) introduced computational thinking as an emerging research area in computer science and education. It has garnered significant attention and has become a focal point in the digital landscape. Li et al. (2015) define computational thinking as "abstract automation," emphasizing the importance of selecting the right abstractions and computers to achieve efficient problem-solving.

Recent research has further explored the cultivation of computational thinking skills in educational settings. Papadakis et al. (2021) investigated the integration of computational thinking in a cloud education model and its impact on students' problem-solving abilities. The study found that cloud-based computational thinking activities significantly improved students' algorithmic and logical reasoning skills, facilitating their transition into competent problem-solvers in various domains.

Related research

According to Ozdamli and Turan (2017) research, project-based learning with technology support has aided students' computational thinking knowledge and skills development in the twenty-first century. Their study compared two groups of students participating in a mobile application development course—one group employing project-based learning steps with technological support, while the other group followed traditional methods. The findings demonstrate the effectiveness of project-based learning in nurturing computational thinking abilities. Recent studies have explored the impact of project-based learning in cloud education on students' cognitive and meta-cognitive skills. According to a comparative analysis between traditional teaching methods and cloud-based project-based learning, cloud-based PBL significantly improved students' cognitive skills, such as problem-solving, critical thinking, and analytical abilities while fostering self-regulation and metacognitive skills. The convergence of Project-Based Learning (PBL) with Cloud Education holds great promise for nurturing students' digital competencies and computational thinking abilities. Recent research showcases the potential of this integration in preparing students to thrive in the digital age, equipping them with essential skills and knowledge to become competent "digital citizens" in a technology-driven world.

Conceptual Framework

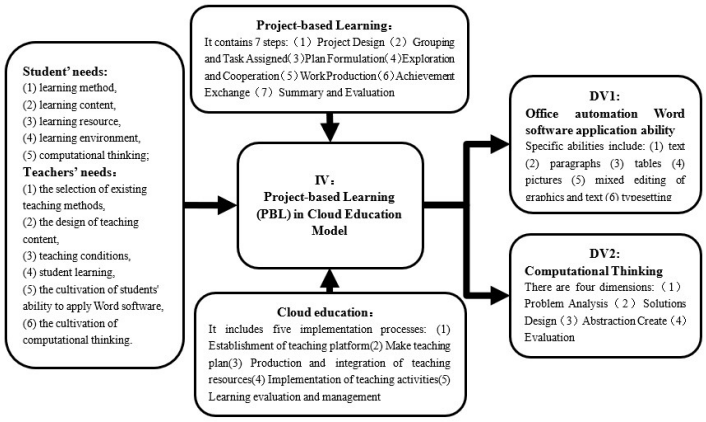

Figure 1: Research framework

RESEARCH METHODOLOGY

The research study is a mixed-methods research design. It combines both quantitative and qualitative data collection and analysis techniques. By integrating both quantitative and qualitative methods, the research aims to provide a comprehensive understanding of the needs of the students, incorporating both numerical data and rich, contextual insights from the teachers' perspectives. This mixed-methods approach allows for a more robust and holistic exploration of the research topic.

The study assessed the needs of the students by distributing a self-developed five-point Likert scale to a sample of one hundred students and conducting interviews with five teachers. The mean and standard deviation were used for the questionnaires to analyze the data, while the content analysis method was applied to the interview data. This approach allowed for a comprehensive understanding of the student's requirements and perspectives and insights from the teachers' viewpoints, contributing to a well-rounded evaluation of the student's needs in the research context.

The second stage included two contents: designing the "Project-Based Learning (PBL) in Cloud Education" teaching model and analyzing the measurement tools, as shown in the following figure:

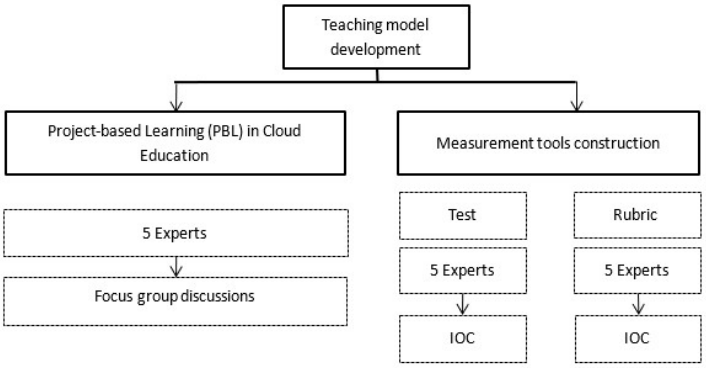

Figure 2: Teaching model

Experiment

In the study, an experiment was conducted to compare the Word software application abilities of students who participated in Project-Based Learning (PBL) within the Cloud Education model with those who experienced Traditional Teaching Methods. The participants were divided into two groups: the experimental group, comprising 32 students, was taught using Project-Based Learning (PBL) within the Cloud Education model, and the control group, also consisting of 32 students, was taught using Traditional Teaching Methods. The groups were randomly selected by using the cluster sampling technique.

Before the intervention, both groups underwent a pre-test to establish a baseline of their Word software application abilities. This pre-testing helped ensure that the groups were comparable regarding their initial skill levels. The study aimed to evaluate and compare the effectiveness of PBL within the Cloud Education model against the conventional teaching approach in enhancing students' Word software application abilities. After teaching for 5 months, the post-test was administered. Research design

EG = P1 + O1 + P2 + O2

CG = P1 + O1 + P2 + O2

Note: EG = Experimental Group (participants exposed to Project-Based Learning in cloud education); CG = Control Group (participants exposed to Traditional Teaching Methods).

Both groups underwent pretest (P1) and posttest (P2) measurements to assess their Word software application ability and computational thinking skills before and after the intervention. By comparing the outcomes (O1 and O2) between the experimental and control groups, the researchers evaluate the effectiveness of the intervention (PBL in cloud education) in improving the participants' skills and competencies.

Data analysis

Table 1: Descriptive statistics for participants' characteristics

Group	n	Mean Age	Gender	Mean (Word Software Application Ability)	Standard Deviation (Word Software Application Ability)
EG	32	21.5	15/17	85.4	7.2
CG	33	21.3	16/17	82.1	6.8

After the intervention, the data will be collected and analyzed using MANOVA to determine whether PBL in cloud education significantly enhances students' Word software application ability and computational thinking skills. MANOVA is an appropriate statistical technique for assessing the relationship between multiple dependent variables (Word software application ability and computational thinking) and a categorical independent variable (PBL in cloud education). The analysis will help provide valuable insights into the effectiveness of PBL in cloud education to improve students' skills and competencies in the context of Word software applications and computational thinking.

Table 2: Results of MANOVA for the effect of project-based learning in cloud education on students' word software application ability and computational thinking skills

Wilks' Lambda (Λ)	F-value	Degrees of Freedom (df)	*p*-value	Partial Eta Squared
0.984	3.872	(4, 114)	.006	0.136

Upon verifying the assumptions, the MANOVA was conducted, and the results revealed a statistically significant difference based on the Wilks' Lambda (Λ = .984, $F(4,114)$ = 3.872, p = .006, partial η^2 = .136) at the α =.05 significance level. The p-value of.006 is less than the significance level (α =.05), indicating statistical significance. Thus, there is a significant effect of Project-Based Learning (PBL) in cloud education on improving students' Word software application abilities and computational thinking skills. This indicates a significant effect of Project-Based Learning (PBL) in cloud education on improving students' Word software application abilities and computational thinking skills. The analysis demonstrates that students who participated in PBL within the cloud education model exhibited higher Word software application ability and computational thinking skills than those who experienced Traditional Teaching Methods. The findings highlight the effectiveness of PBL in cloud education as a valuable approach for enhancing students' practical competencies and problem-solving capabilities in the digital age.

RESULTS OF CONTENT ANALYSIS FROM INTERVIEWS WITH TEACHERS

Positive impact on student engagement

All five teachers unanimously expressed that Project-Based Learning (PBL) within the Cloud Education model significantly impacted student engagement in the Word software course. They emphasized that PBL created an interactive and dynamic learning environment, fostering active participation and intrinsic motivation among students. The hands-on nature of PBL projects captured students' interest, making the learning process enjoyable and meaningful. As a result, students were more eager to explore and apply their knowledge to real-world problems, increasing engagement and enthusiasm in the classroom.

Improved problem-solving skills

The teachers observed a notable improvement in students' problem-solving skills as a direct outcome of PBL in cloud education. They reported that PBL encouraged students to think critically and analytically when faced with challenges in the Word software application. Through working on authentic projects, students developed the ability to identify problems, devise creative solutions, and evaluate the effectiveness of their strategies. The teachers acknowledged that PBL nurtured students' computational thinking, empowering them to confidently tackle complex tasks.

Collaboration and teamwork

A key theme from the interviews was the emphasis on collaboration and teamwork. All teachers noted that PBL in cloud education promoted collaborative learning experiences where students worked in teams to complete projects. The teachers praised the positive impact of teamwork on students' interpersonal skills, communication skills, and cooperative abilities. They observed that students not only learned from one another but also developed essential soft skills required for effective teamwork, which are essential for success in the modern workplace.

Enhanced software application proficiency

The teachers said PBL significantly enhanced students' Word software application proficiency. They observed that students gained hands-on experience by working on authentic projects, contributing to their confidence in navigating the software and utilizing its features efficiently. PBL allowed students to apply theoretical knowledge to practical tasks, resulting in a deeper understanding of the software's functionalities and increased proficiency in using it effectively.

Real-World relevance

Teachers consistently emphasized the real-world relevance of PBL in cloud education. They recognized that PBL projects closely mirrored actual workplace scenarios, enabling students to connect their learning to real-life applications. The teachers believed

that this approach motivated students to excel academically and equipped them with practical skills and knowledge necessary for future career success in the digital age.

Challenges in implementation

While the overall feedback on PBL in cloud education was positive, some teachers mentioned challenges during implementation. These challenges included time constraints for project completion, the need for continuous technological support, and ensuring equitable participation within student teams. Despite these challenges, the teachers acknowledged that the benefits of PBL outweighed the difficulties, making it a valuable teaching approach for fostering holistic student development.

The content analysis of the interviews with teachers revealed a strong consensus regarding the positive impact of PBL in cloud education on students' Word software application ability and computational thinking skills. The findings highlighted the effectiveness of PBL as an innovative and engaging pedagogical approach that fosters active learning, collaboration, and practical skill development among students. The insights obtained from the teachers' perspectives added depth and richness to the quantitative data, providing a comprehensive understanding of the educational benefits of PBL in the context of Word software courses.

DISCUSSION

The findings of this research align with the literature review, reinforcing the significance of digital education, project-based learning, and cloud education in the context of the contemporary digital era. According to Zhou (2023), college students from the post-2000 generation are "digital aborigines," implying that they are innately tech-savvy. However, this intrinsic exposure to technology alone does not suffice to elevate them to qualified "digital citizens." Instead, to thrive in the digital landscape and transition into competent "digital citizens," students must demonstrate an innovative spirit, practical skills, and an earnest commitment to embracing digital learning as a conduit for augmenting their independent development and overall competencies.

Consistent with the findings of Fraillon et al. (2014), this study underscores the crucial necessity for adaptation to the information society and the rapidly evolving digital era. It emphasizes the essentiality of continuous learning to transform students into qualified "digital citizens" who can adeptly navigate the wealth of knowledge and technological advancements prevalent in contemporary society.

As explored in this research, the integration of project-based learning and teaching within the cloud education model corroborates the insights of Özyurt and Özyurt (2015). The prevailing prevalence of digital education, encompassing both E-learning and cloud education, has become the norm in modern learning environments. Cloud education emerges as a comprehensive approach leveraging cloud computing technology to enhance the learning experience. This research affirms that the profound amalgamation of project-based learning within the cloud education model distinctly impacts students' abilities, fostering active learning, collaborative engagement, and honing real-world problem-solving skills.

The concept of information-based instructional design utilizing cloud education, resonates with the methodological approach undertaken in this study. By implementing project-based learning within the cloud education framework, the research design aligns with a transformative restructuring of traditional courses guided by pertinent learning theories. The assimilation of this instructional design significantly enhances students' learning efficiency, bestowing them with substantial advantages concerning skill development and knowledge acquisition.

While the present research highlights the positive impact of integrating Project-Based Learning (PBL) within the Cloud Education model on students' Word software application ability and computational thinking, it is essential to acknowledge that some contrasting findings exist in the literature.

For instance, a study by Cukurbasi and Kiyici (2018) reported that implementing PBL in the Cloud Education model did not significantly improve students' application abilities in specific technical courses like Word software. Their research found that traditional teaching methods were equally effective in achieving learning outcomes related to software application skills.

Additionally, Zheng et al. (2021) conducted a meta-analysis of various studies looking at the efficacy of

cloud education and PBL. Surprisingly, their findings revealed that the integration of PBL within the Cloud Education model did not consistently yield significant improvements in computational thinking skills among students. Some studies even indicated that traditional teaching methods were more effective in promoting computational thinking abilities.

Moreover, a research study by Wang (2023) reported mixed results regarding students' interest and engagement with PBL in the Cloud Education model. While some students demonstrated increased enthusiasm and collaboration, others found the virtual learning environment challenging and less interactive than traditional face-to-face instruction. These contrasting findings suggest that the impact of integrating PBL within the Cloud Education model on students' Word software application ability and computational thinking can vary based on various factors, including the course content, student demographics, and instructional approaches. It highlights the need for further research to explore the intricacies and nuances of implementing innovative teaching models in the digital age.

Practical and theoretical implications

In this research, integrating Project-Based Learning (PBL) within the Cloud Education model benefits students' proficiency in Word software applications and computational thinking. The combination of PBL and cloud education offers flexible learning opportunities, allowing students to access resources and collaborate from any location with internet connectivity. Cloud-based tools streamline project completion by enabling collaborative work and real-time feedback, enhancing productivity and time management skills. The new teaching model emphasizes comprehensive assessment, considering practical skills, knowledge, and technical mastery, fostering well-rounded student development.

The study emphasizes the potential advantages of integrating diverse teaching models, such as PBL and cloud education, to create a more engaging learning experience. It highlights the significance of lifelong learning and digital literacy in today's educational landscape, as students require adaptable skills to thrive in the dynamic digital era. The focus on computational thinking in the integrated model fosters innovative problem-solving abilities, aligning with the growing recognition of computational thinking's importance in various fields. The research underscores the role of technology, particularly cloud-based tools, in facilitating enhanced learning experiences for students and educators. Overall, this innovative approach signifies the necessity of digital literacy in contemporary education, preparing students to succeed in an ever-changing digital world.

Limitations and future directions

The present research, while providing valuable insights into the integration of Project-Based Learning (PBL) within the Cloud Education model, has certain limitations, such as the fact that the total sample size of 65 students in the experimental and control groups may be relatively small, potentially limiting the generalizability of the findings to a larger population. External factors could influence the results, such as students' prior knowledge, previous exposure to PBL or cloud education, and individual learning styles. The study was conducted within a specific educational setting, and contextual factors unique to that environment could influence the results. Replicating the research in different educational settings could help validate the findings across diverse contexts.

Thus, conducting studies with larger and more diverse samples increases the generalizability of the findings. Including students from different educational levels, institutions, and backgrounds can provide a more comprehensive perspective on the effectiveness of the teaching model. Implementing longitudinal studies that extend the intervention period to assess the long-term impact of PBL within the Cloud Education model on students' Word software application ability and computational thinking Follow-up assessments over an extended period will provide insights into the sustainability of the observed improvements. Similarly, to account for potential confounding variables, such as students' prior knowledge and learning styles, conducting subgroup analyses or using statistical techniques may provide control for these factors.

CONCLUSION

The research results indicate that the profound integration of Project-Based Learning (PBL) within the Cloud Education model positively impacts

students' Word software application ability and computational thinking. This new teaching model combines the strengths of PBL and cloud education, expanding the scope of knowledge acquisition and fostering lifelong learning. It offers flexible learning opportunities and efficient project completion, enhancing students' project-based learning experiences. Moreover, it provides comprehensive assessment, focusing on knowledge, technical mastery, and practical skills, encouraging innovative and computational thinking. Overall, this innovative approach signifies the necessity of digital literacy in today's educational landscape and prepares students to thrive in the dynamic digital era

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