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Enhancing Student Learning Outcomes in Blended Nursing Education: Insights from a Public College in Shanghai, China

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Abstract

Purpose Assess the current levels of learning motivation, behavioral engagement, cognitive engagement, emotional engagement, agentic engagement, and feedback among nursing students. **Research design, data, and methodology:** A sequential exploratory mixed-methods design was employed, integrating qualitative and quantitative approaches to develop a comprehensive data collection instrument. The target population included nursing students from three public colleges in Shanghai, resulting in a sample size of 1,494 students. For the Intervention, Development, and Implementation (IDI) phase, 30 students were randomly selected and invited to participate 14-weeks assessment. The Index of Item-Objective Congruence (IOC) assessment and pilot test are conducted. The researcher performed a Multiple Linear Regression (MLR) analysis on 1,494 survey responses. After, the researcher conducted a paired-sample t-test analysis on all six variables to determine if there were any differences in students' learning performance between the pre-IDI and post-IDI phases. **Results:** The results in a multiple regression analysis demonstrated that all factors learning motivation, behavioral engagement, cognitive engagement, emotional engagement, agentic engagement, and feedback significantly predicted learning performance. **Conclusions:** Based on these findings, a theoretical model was developed and validated by experts, laying the groundwork for future interventions aimed at enhancing nursing students' learning performance.

Keywords: Student Learning Performance, Behavioral Engagement, Emotional Engagement

JEL Classification Code: I23, J28, L2

1. Introduction

As technology and the internet evolve rapidly, blended learning has emerged as a preferred educational method in vocational nursing studies. This approach combines traditional classroom instruction with online learning, providing students with a diverse range of activities to enhance their understanding and skills. Blended learning offers numerous benefits, including increased flexibility and accessibility, personalized learning experiences, and improved student engagement and academic performance (Li & Wang, 2022). However, the effectiveness of blended learning in vocational nursing education depends on careful design and implementation. It is essential to investigate the factors influencing student academic performance in this context to maximize its effectiveness (Kang & Kim, 2021). While previous research suggests that learning motivation, active participation, and constructive feedback positively correlate with student performance, their interplay within a blended learning environment remains largely unexplored (Gjestvang et al., 2021).

The early 21st century has seen an unprecedented integration of digital technology into educational practices, leading to the blended learning model—a pedagogical approach that merges traditional face-to-face instruction with online learning activities. This model has been widely adopted across various disciplines, including health sciences and nursing education. Globally, blended learning is praised for its flexibility, accessibility, and potential to enhance learning outcomes (Allen et al., 2007; Graham, 2006). In

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nursing education, this approach is especially relevant due to the profession's practical nature and the ongoing need for professional development in response to rapid advancements in healthcare (Sharpe et al., 2006).

The effectiveness of blended learning in nursing education has become a focal point of educational research. International studies indicate that blended learning can enhance student engagement, satisfaction rates, and academic performance compared to traditional learning methods (Billings & Halstead, 2012). A meta-analysis by Means et al. (2013) found that students in blended learning environments often outperform those in fully online or face-to-face courses, suggesting a synergistic effect of combining both methods.

In China, the transition to blended learning in vocational education aligns with the country's educational reform goals, which emphasize innovative teaching methods and improved learning quality (Ministry of Education of the People's Republic of China, 2010). The Chinese government is committed to enhancing nursing education standards, which is crucial for addressing the healthcare needs of its growing and aging population (Zhang et al., 2008). In this context, blended learning serves not only as a pedagogical choice but also as a strategic educational policy aimed at strengthening the competencies of nursing professionals (Li & Wang, 2022).

Shanghai's educational landscape is characterized by innovative teaching and learning approaches. The city's strategic educational reform plan includes significant investments in educational technology and teacher training, aiming to create a more flexible and dynamic learning environment (Shanghai Municipal Education Commission, 2015). The integration of blended learning within nursing vocational education in Shanghai reflects these broader trends, positioning the city's educational institutions as leaders in the field (Xu & Wang, 2014).

Consequently, the importance of this study lies in its potential to provide valuable insights into the factors influencing student performance in blended learning within the context of vocational nursing education in Shanghai. The findings from this study are expected to assist educators and curriculum designers in developing more engaging and effective blended learning courses for vocational nursing students. Ultimately, this could contribute to the cultivation of skilled and compassionate healthcare professionals.

2. Literature Review

2.1 Student Learning Performance

Student learning performance is a complex concept that can be interpreted in different ways, depending on the educational context and the specific outcomes being evaluated. Generally, it refers to the degree to which students meet the intended learning goals, which may include knowledge acquisition, skill development, and changes in attitudes (Bloom, 1956; Kirkpatrick, 1967).

In nursing vocational education, performance is often associated with both theoretical understanding and practical skills crucial for clinical environments (McCoy, 2017). Blended learning settings, which combine online digital resources with traditional classroom instruction, necessitate a holistic approach to assessing learning performance that takes into account both online and in-person interactions (Garrison & Kanuka, 2004).

Research suggests that student learning performance in blended nursing programs can be evaluated through various assessment methods, such as traditional tests, practical skill evaluations, self-assessments, peer reviews, and reflective journals (Anderson, 2010). Utilizing these diverse assessment tools aligns with the idea that performance in nursing education should reflect real-world clinical skills, rather than solely theoretical knowledge (Petty, 2009).

In the context of nursing vocational education, performance assessment is particularly intricate due to the essential link between theoretical understanding and clinical application. Blended learning, which generally includes both online learning and face-to-face interaction, complicates the definition and measurement of student performance. The online components may focus on grasping theoretical concepts through interactive modules and virtual simulations, while in-person elements emphasize the practical application of knowledge in clinical skills labs and real-world experiences (Graham, 2006; Means et al., 2013).

In these hybrid learning environments, performance can be assessed through various metrics, such as academic achievement, practical skill demonstrations, clinical decision-making capabilities, and reflective practices that indicate professional development (Means et al., 2013).

2.2 Learning Motivation

Learning motivation, an essential psychological factor, significantly impacts students' performance, particularly in blended learning settings. This approach to education demands a greater level of self-regulation, making motivation a crucial element for academic achievement (Zimmerman, 2002).

Intrinsic motivation, which stems from a genuine interest and enjoyment in the learning process, is strongly linked to academic success. Students who exhibit high intrinsic motivation generally attain better academic results than those with lower motivation levels (Ryan & Deci, 2000).

Conversely, extrinsic motivation, which is driven by external rewards or the desire to avoid negative

consequences, also affects academic performance. While it can enhance performance on routine or straightforward tasks, its effectiveness may wane with more complex or conceptual challenges (Deci & Ryan, 2000).

In nursing vocational education, learning motivation is especially vital due to the rigorous nature of the curriculum and the requirement for significant commitment. Students who are more motivated are likely to perform better in both theoretical and practical assessments (Newton et al., 2009).

In summary, the connection between learning motivation and student performance is intricate and shaped by various factors, including task characteristics, the learning environment, and individual student attributes.

H1: Learning motivation has a significant impact on student learning performance in blended learning.

2.3 Behavioral Engagement

Behavioral engagement is a key component of student engagement, along with emotional and cognitive engagement. It encompasses the observable actions and behaviors students display during their learning process, such as participating actively in academic activities, following classroom rules, and getting involved in social and extracurricular activities (Eryilmaz & Altinsoy, 2021). These actions range from engagement in learning tasks to regular attendance and the effort invested in educational activities (Garrison & Kanuka, 2004).

In nursing vocational education within blended learning environments, behavioral engagement manifests in various ways. This includes interaction with the learning management system, active participation in online discussions, contributions to group work, and engagement in face-to-face classes and practical simulations. The hybrid nature of blended learning offers students multiple avenues for behavioral engagement, potentially enriching their learning experiences and outcomes. Research consistently shows a strong link between behavioral engagement and student performance. A meta-analysis by Lee and Choi (2020) found that higher levels of behavioral engagement correlate with better academic performance across educational levels and disciplines, including vocational education (Lee & Choi, 2020). Moreover, other studies highlight that students with higher behavioral engagement tend to persist in their studies, have lower dropout rates, and achieve greater academic success (Chen, 2023).

In blended learning, the relationship between behavioral engagement and learning performance is further nuanced by the dual modality of instruction. Behavioral engagement in this context includes participation in both face-to-face activities and engagement with digital resources and online tasks (Graham et al., 2023). Consequently, a student's ability to effectively engage with both online and offline resources may impact the correlation between behavioral engagement and learning performance.

Although a strong association exists between behavioral engagement and student learning performance, this relationship is not straightforward. It can be influenced by factors such as the learning environment, instructional strategies, the nature of tasks or activities, and individual student characteristics (Hamre & Pianta, 2015). For example, tasks perceived as relevant and meaningful can boost behavioral engagement, leading to improved learning performance. Similarly, a supportive learning environment that encourages active participation and offers opportunities for engagement can enhance the impact of behavioral engagement on learning outcomes (Black & Wiliam, 1998).

In summary, behavioral engagement plays a critical role in student learning performance, especially in blended learning environments, but it does not operate in isolation. It interacts with various elements of the learning environment and is influenced by individual student characteristics. Therefore, educators and institutions should carefully design and implement blended learning programs to maximize behavioral engagement and enhance student learning outcomes.

H2: Behavioral engagement has a significant impact on student learning performance in blended learning.

2.4 Cognitive Engagement

Cognitive engagement refers to the level of intellectual commitment and effort that students invest in their learning. This includes elements such as focus, interest, motivation, and the use of advanced learning strategies like problem-solving, critical thinking, and metacognition (Fredricks et al., 2004). It plays a crucial role in students' learning and achievement as it affects how they process and retain new information.

Empirical studies consistently show a positive relationship between cognitive engagement and student learning performance. For example, Greene (2015) found that students who reported higher levels of cognitive engagement generally achieved better academic results across various disciplines.

In blended learning environments, which combine online and in-person instruction, cognitive engagement is particularly important. Research suggests that such environments can foster deeper cognitive engagement, leading to improved learning outcomes (Akyol & Garrison, 2011). In these settings, students can take advantage of the flexibility and resources offered by online learning while still benefiting from the social and instructional interactions typical of traditional classrooms.

In the field of Nursing Vocational Education, which demands a significant amount of both theoretical and

practical knowledge, fostering cognitive engagement is crucial. Sulistyawati and Latief (2015) conducted a study specifically examining the impact of cognitive engagement on learning outcomes among nursing students. Their findings highlighted the positive effect of cognitive engagement on these outcomes.

In conclusion, the positive correlation between cognitive engagement and student learning performance highlights the importance of designing and implementing blended learning environments that encourage active learning and critical thinking.

H3: Cognitive engagement has a significant impact on student learning performance in Blended Learning

2.5 Emotional Engagement

Emotional engagement refers to the emotions and attitudes that students hold toward their learning environment, including their instructors, peers, and the learning material. It involves their interests, motivations, and values, which play a crucial role in their academic performance (Fredricks et al., 2004).

In the context of blended learning, which combines online and face-to-face instruction, emotional engagement gains new significance. These environments offer diverse emotional experiences through multimedia and interactive elements, which can boost students' interest and motivation, thereby enhancing their emotional engagement (Castellanos-Reyes, 2020).

In Nursing Vocational Education, where empathy and emotional intelligence are vital, emotional engagement is particularly important. Chan (2010) identified a link between emotional engagement in nursing education and improved learning outcomes.

Emotional engagement significantly influences the depth of students' learning and understanding by affecting their motivation, concentration, and perseverance. Positive emotions have been shown to enhance learning by improving students' ability to process information and by fostering a deeper, more personal connection to the material (Pekrun & Linnenbrink-Garcia, 2014).

For nursing students, nurturing emotional engagement is especially critical due to the nature of their profession. Emotional engagement in the learning process can help these students better understand and empathize with the emotional experiences of their future patients, which is essential for providing high-quality patient care (Beauvais et al., 2014).

Top of Form

Bottom of Form

H4: Emotional engagement has a significant impact on student learning performance in blended learning.

2.6 Agentic Engagement

Agentic engagement is a relatively recent concept in educational research, highlighting students' active and constructive involvement in their learning process. It emphasizes the proactive and intentional role students take in shaping their educational experiences, influencing instructional activities, learning resources, and academic tasks (Reeve & Tseng, 2011).

In Nursing Vocational Education, agentic engagement can be especially valuable. By taking an active role in their learning, nursing students may more effectively transfer knowledge and skills to their professional practice, ultimately improving their ability to deliver quality patient care (D'Amore et al., 2012).

Agentic engagement involves students being self-regulated, proactive, and taking ownership of their learning process. This type of engagement enables learners to play a more active role in their education, shaping the learning environment and educational process to better meet their needs (Reeve, 2013).

In blended learning environments, agentic engagement becomes particularly important. The combination of online and in-person educational components provides students with unique opportunities to exercise autonomy in their learning. Online platforms allow students to control the pace, sequence, and content of their learning, while in-person interactions offer opportunities to discuss learning objectives, seek clarification, and influence the way teaching activities are conducted (Staker & Horn, 2012).

In the field of Nursing Vocational Education, fostering agentic engagement can be crucial for preparing students for their future careers. The nursing profession demands individuals who are proactive, self-directed, and capable of making informed decisions. This aligns well with the concept of agentic engagement, suggesting that cultivating this type of engagement in nursing students could enhance their professional competence and patient care skills (D'Amore et al., 2012).

Top of Form

Bottom of Form

H5: Agentic engagement has a significant impact on student learning performance in blended learning.

2.7 Feedback

In educational contexts, feedback refers to the insights provided by a source (such as a teacher, peer, textbook, or digital tool) regarding specific aspects of an individual's performance or understanding (Shute, 2008). It is crucial in effective teaching and learning, as it helps learners identify what they need to do to improve their performance.

In blended learning environments, feedback can take on various forms and be delivered through multiple channels. For example, feedback might be immediate or delayed, personalized or general, and can be provided either face-to-face or online. The digital aspect of blended learning offers additional opportunities for timely, continuous, and personalized feedback, which can enhance student learning outcomes (Winstone & Carless, 2021).

Feedback is particularly important in Nursing Vocational Education. Given the practical nature of the field, receiving regular, constructive feedback on performance helps students identify their strengths and weaknesses, refine their skills, and improve their clinical practice (McCarthy, 2020). Feedback serves as a strategic tool for guiding students toward their learning goals by allowing them to reflect on their performance, understand their progress, and make necessary adjustments to their learning strategies (Hattie & Timperley, 2007).

In blended learning environments, feedback becomes even more vital. The integration of technology in these settings allows for real-time, personalized feedback, which can significantly enhance students' learning experiences. Digital tools can offer immediate feedback on online quizzes, facilitate peer-to-peer feedback through discussion forums, and enable teachers to provide detailed written feedback on digital assignments (Sun et al., 2018).

In the context of Nursing Vocational Education, feedback plays a crucial role in developing competent, self-regulated, and reflective practitioners. Timely and constructive feedback on clinical skills, decision-making abilities, and professional behaviors helps students continuously improve, preparing them for the demands of their future careers (Bing-Jonsson et al., 2016).

In blended learning settings, feedback takes on even greater importance. The combination of online and in-person learning experiences expands the ways feedback can be delivered. Online platforms can provide automated, immediate feedback, while face-to-face interactions allow for personalized, in-depth feedback discussions (Halverson & Graham, 2019).

3. Research Methods and Materials

3.1 Research Framework

The researcher applied three theoretical models from Nguyen & Nguyen (2010), Raza et al. (2020), and Rana and Dwivedi (2017). These frameworks collectively supported and informed the development of the conceptual framework presented in Figure 1.

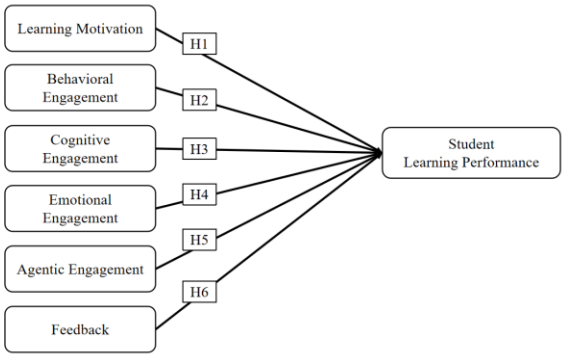

Figure 1: Conceptual Framework

H1: Learning motivation has a significant impact on student learning performance in blended learning.
H2: Behavioral engagement has a significant impact on student learning performance in blended learning.
H3: Cognitive engagement has a significant impact on student learning performance in blended learning.
H4: Emotional engagement has a significant impact on student learning performance in blended learning.
H5: Agentic engagement has a significant impact on student learning performance in blended learning.
H6: Feedback has a significant impact on student learning performance in blended learning.

3.2 Research Methodology

The thesis thoroughly examines each phase of action research, beginning with the investigative stage called pre-IDI, which focuses on understanding the current conditions and identifying areas in need of improvement. To accomplish this, the study integrates various research methods, starting with a qualitative approach. This phase primarily involves observations and interviews, with the observer acting as a neutral party, attending employment guidance classes to assess student engagement and performance. The feedback gathered from these sessions provides qualitative data for the pre-IDI analysis.

Following the qualitative phase, the study transitions to a quantitative approach, utilizing Wenjuanxing for systematic data collection after verifying the survey's validity and reliability. A carefully vetted questionnaire is distributed to a sample of 1,494 students to explore the relationships between different independent and dependent variables. The data is then analyzed using multiple linear regression in SPSS to refine the conceptual framework and hypotheses for the later chapters.

Once the framework is established, an intervention plan is developed, informed by the identified independent variables and hypotheses. This intervention, detailed in the following section, involves a group of 30 students from the

control group initiative and spans 14 weeks, as outlined in the third chapter.

After the intervention, the post-IDI stage begins, employing both qualitative and quantitative methods to assess the effectiveness of the interventions. This includes redistributing questionnaires, revisiting observations, and conducting new interviews. The resulting data is then analyzed and compared to validate the impact of the organizational development interventions.

3.3 Research Population, Sample Size, and Sampling Procedures

3.3.1 Research Population

The research subjects of this study are three-year college students majoring in nursing from three institutions: Shanghai Nanhu Vocational and Technical College, Shanghai Urban Construction Vocational College, and Shanghai Jiguang Vocational and Technical College. The researchers selected three courses from two grade levels within the vocational nursing program, specifically: Nursing Etiquette and Interpersonal Communication, Nursing Fundamentals, and Pediatric Nursing. Among these, 560 students are enrolled in Nursing Etiquette and Interpersonal Communication, 490 in Nursing Fundamentals, and 603 in Pediatric Nursing. According to the Morgan table, the total sample size is 681 students. These students constitute the research population for this study.

3.3.2 Sample size

The researcher began with a pilot survey involving a randomly selected sample of 30 students to evaluate the reliability of the measurement instrument through a pilot test. Following this, the researcher identified a research population of 1,653 students and obtained 1,494 valid responses. Multiple linear regression analysis was then utilized to explore the relationship between the independent and dependent variables. Finally, a subset of 30 voluntary students took part in the IDI (Intervention, Development, and Implementation) stage.

3.3.3. Sampling Procedures

The researcher reached out to various groups of participants using the following sampling methods:

Sampling 1: Pilot Survey and Pilot Test

Thirty randomly chosen students were invited to participate in both the pilot survey and pilot test. They were asked to complete the survey questionnaire and offer feedback on their experience.

Sampling 2: Pre-survey

The pre-survey involved inviting 1,494 students from different academic years to complete printed survey questionnaires. After thorough review, 1,494 valid responses were confirmed.

Sampling 3: Sampling for IDI

For the IDI phase, 30 students were randomly selected and invited to participate.

3.4 Research Instruments

3.4.1 Design of Questionnaire

Step 1: Identify questionnaire sources from three publicly available articles (Rana & Dwivedi, 2017; Raza et al., 2020; Trang et al., 2010).

Step 2: Adapt and present the survey questionnaires in the context of Chinese university students.

Step 3: Conduct an Implementation of Content Validity Index (IOC).

3.4.2 Components of Questionnaire

The survey questionnaire consisted of two sections:

Part 1: Basic Information Questions. This section collected fundamental details about the research population, including gender, age, and other demographic information.

Part 2: This section included 26 questions categorized into six dimensions:

-Learning Motivation (4 questions)
-Behavioral Engagement (4 questions)
-Cognitive Engagement (4 questions)
-Emotional Engagement (3 questions)
-Agentic Engagement (3 questions)
-Feedback (4 questions)

3.4.3 IOC Results

The researcher engaged five independent experts, all of whom were Chinese professors, to perform the Index of Item-Objective Congruence (IOC) assessment. These experts used a scoring system to evaluate each questionnaire item, assigning +1 for "Congruent," 0 for "Questionable," and -1 for "Incongruent." In this study, every questionnaire item received scores exceeding 0.67, indicating a satisfactory level of congruence. Consequently, the researcher chose to keep all the questionnaire items for further analysis.

3.4.4 Pilot survey and Pilot test results

A pilot survey was conducted in which a questionnaire was distributed to 30 randomly selected students who were asked to provide feedback. Cronbach's Alpha was then used to evaluate the internal consistency reliability of the constructs. As per the guidelines by Nunnally and Bernstein (1994), a reliability value of 0.7 or higher is considered acceptable. The results shown in the table below indicate that each construct achieved a high level of reliability.

Table 1: Pilot Test Result

Variables	No. of items	Sources	Cronbach's Alpha	Strength of association
Student Learning Performance	4	Trang et al. (2010)	0.92	Excellent
Learning Motivation (LM)	4	Trang et al. (2010)	0.857	Good
Behavioral Engagement (BE)	4	Raza et al. (2020)	0.863	Good
Cognitive Engagement (CE)	4	Raza et al. (2020)	0.912	Excellent
Emotional Engagement (EE)	3	Raza et al. (2020)	0.859	Good
Agentic Engagement (AE)	3	Raza et al. (2020)	0.795	Acceptable
Feedback (FDB)	4	Rana and Dwivedi (2017)	0.901	Excellent

4. Results and Discussion

4.1 Results

4.1.1 Demographic Profile

The researcher presented the demographic profile of the entire research population (n=1494), followed by a profile of the selected group of students (n=30) who participated in the self-development plan, as shown in Table 2.

Table 2: Demographic Profile

Entire Research Population (n=1,494)		Frequency	Percent
Gender	Male	333	22.29%
	Female	1161	77.71%
Year	First Year	556	37.22%
	Second Year	712	47.66%
	Third Year	225	15.13%
Age	18-19	577	41.03%
	20-21	813	38.62%
	22-23	93	6.22%
	24 years and above	7	0.47%
Total		**1494**	**100%**
IDI Participants (n=30)		**Frequency**	**Percent**
	Male	2	6.67%
	Female	28	93.33%
Year	First Year	0	0%
	Second Year	20	100%
	Third Year	0	0%
Age	18-19	12	40%
	20-21	18	60%
	22-23	0	0%
	24 years and above	0	0%
Total		**30**	**100%**

4.1.2 Results of multiple linear regression

The researcher performed a Multiple Linear Regression (MLR) analysis on 1,494 survey responses to test the support for each of the five research hypotheses, all of which pertained to the dependent variable of student learning performance. To check for multicollinearity, a variance inflation factor (VIF) analysis was conducted, revealing that multicollinearity was not an issue, as the VIF values were below the acceptable threshold of 5 (Hair et al., 1995). The R-squared (R^2) value of the regression model, which included five independent variables, was 0.916, indicating that the model explains 91.6% of the variability in student learning performance, demonstrating its strong explanatory power.

Table 3: The multiple linear regression of five independent variables on student learning performance

Variables	Standardized Coefficients Beta value	t-value	p-value	VIF	R^2
Learning Motivation (LM)	0.719	1.330	0.014*	6.753	0.916
Behavioral Engagement (BE)	0.067	2.905	0.004**	9.397	
Cognitive Engagement (CE)	0.182	6.629	0.000**	13.381	
Emotional Engagement (EE)	0.041	1.680	0.000**	10.675	
Agentic Engagement (AE)	0.037	2.234	0.026*	7.909	
Feedback (FDB)	0.670	29.199	0.000**	9.375	

Note: p-value <0.05*, p-value <0.001**

In conclusion, the multiple linear regression analysis results validated hypotheses H1, H2, H3, H4, and H5. Building on these findings, the following hypotheses were formulated for the subsequent (IDI):

H7: There is a significant mean difference in learning motivation between pre-IDI and post- IDI.

H8: There is a significant mean difference in behavioral engagement between pre-IDI and post- IDI.

H9: There is a significant mean difference in cognitive engagement between pre-IDI and post- IDI.

H10: There is a significant mean difference in emotional engagement between pre-IDI and post- IDI.

H11: There is a significant mean difference in agentic engagement between pre-IDI and post- IDI.

H12: There is a significant mean difference in feedback between pre- IDI and post- IDI.

4.2 IDI Intervention Stage

The IDI spanned 14 weeks and was designed to enhance students' learning performance, using both quantitative and qualitative data collected at the pre-IDI stage. The researcher presented the IDI in a chronological sequence, as shown in Figure 2.

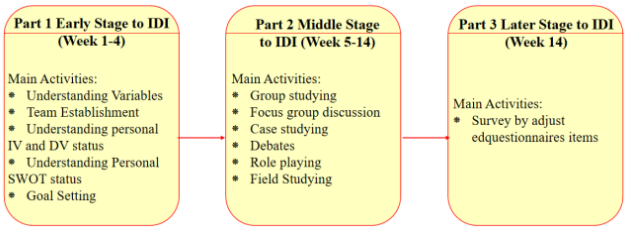

Figure 2: IDI Activities

4.3 Results Comparison between Pre-IDI and Post-IDI

The researcher conducted a paired-sample t-test analysis on all six variables to determine if there were any differences in students' learning performance between the pre-IDI and post-IDI phases. The tables below present the results of the paired-sample t-test analysis for each of the six variables as follows:

Table 4: Paired-Sample T-Test Results

Variables	Mean	SD	SE	p-value
Learning Motivation				
Pre-IDI	3.742	0.829	0.151	P<0.01
Post-IDI	4.442	0.494	0.090	
Behavioral Engagement				
Pre-IDI	3.808	0.865	0.158	P<0.01
Post-IDI	4.483	0.487	0.089	
Cognitive Engagement				
Pre-IDI	3.825	0.758	0.138	P<0.01
Post-IDI	4.483	0.450	0.082	
Emotional Engagement				
Pre-IDI	3.778	0.907	0.166	P<0.01
Post-IDI	4.467	0.492	0.090	
Agentic Engagement				
Pre-IDI	3.567	0.906	0.165	P<0.01
Post-IDI	4.444	0.589	0.108	
Feedback				
Pre-IDI	3.808	0.830	0.152	P<0.01
Post-IDI	4.567	0.445	0.081	
Student Learning Performance				
Pre-IDI	3.858	0.819	0.150	P<0.01
Post-IDI	4.517	0.482	0.088	

Table 4 presents the results of the paired-sample t-test analysis comparing the pre-IDI and post-IDI stages:

Learning Motivation: There is a significant increase in learning motivation between the post-IDI stage (M=4.442, SD=0.494, SE=0.090) and the pre-IDI stage (M=3.742, SD=0.829, SE=0.151), with P<0.01 and a mean difference of 0.700. Therefore, H1: There is a significant difference in Learning Motivation between the Pre-IDI and Post-IDI stages.

Behavioral Engagement: There is a significant increase in behavioral engagement between the post-IDI stage (M=4.483, SD=0.487, SE=0.089) and the pre-IDI stage (M=3.808, SD=0.865, SE=0.158), with P<0.01 and a mean difference of 0.675. Therefore, H2: There is a significant difference in Behavioral Engagement between the Pre-IDI and Post-IDI stages.

Cognitive Engagement: There is a significant increase in cognitive engagement between the post-IDI stage (M=4.483, SD=0.450, SE=0.082) and the pre-IDI stage (M=3.825, SD=0.758, SE=0.138), with P<0.01 and a mean difference of 0.658. Therefore, H3: There is a significant difference in Cognitive Engagement between the Pre-IDI and Post-IDI stages.

Emotional Engagement: There is a significant increase in emotional engagement between the post-IDI stage (M=4.467,

SD=0.492, SE=0.090) and the pre-IDI stage (M=3.778, SD=0.907, SE=0.166), with P<0.01 and a mean difference of 0.689. Therefore, H4: There is a significant difference in Emotional Engagement between the Pre-IDI and Post-IDI stages.

Agentic Engagement: There is a significant increase in agentic engagement between the post-IDI stage (M=4.444, SD=0.589, SE=0.108) and the pre-IDI stage (M=3.567, SD=0.906, SE=0.165), with P<0.01 and a mean difference of 0.877. Therefore, H5: There is a significant difference in Agentic Engagement between the Pre-IDI and Post-IDI stages.

Feedback: There is a significant increase in feedback between the post-IDI stage (M=4.567, SD=0.445, SE=0.081) and the pre-IDI stage (M=3.808, SD=0.830, SE=0.152), with P<0.01 and a mean difference of 0.759. Therefore, H6: There is a significant difference in Feedback between the Pre-IDI and Post-IDI stages.

Student Learning Performance: There is a significant increase in student learning performance between the post-IDI stage (M=4.517, SD=0.482, SE=0.088) and the pre-IDI stage (M=3.858, SD=0.819, SE=0.150), with P<0.01 and a mean difference of 0.659. Therefore, H7: There is a significant difference in Student Learning Performance between the Pre-IDI and Post-IDI stages.

In summary, the paired-sample t-test results indicate that all seven variables showed significant mean differences between the post-IDI and pre-IDI stages. Additionally, the researcher found a significant improvement in students' academic achievement between the pre-IDI and post-IDI phases.

5. Conclusions, Recommendations and Limitations

5.1 Conclusions & Discussions

The study explored the impact of six independent variables—learning motivation, behavioral engagement, cognitive engagement, emotional engagement, agentic engagement, and feedback—on the dependent variable of student learning performance. The research utilized a thorough design, data collection, and methodology to derive meaningful insights.

The research design included the Index of Item-Objective Congruence (IOC) for validity and Cronbach's Alpha during a pilot test to ensure the reliability of the measurement tools. This meticulous approach to measurement enhanced the study's credibility. Data were gathered from 1,494 valid responses from students engaged in blended learning for nursing vocational education at a public college in Shanghai and analyzed using multiple linear regression to identify significant relationships between the independent and dependent variables. Additionally, a 14-week Intervention Design Implementation (IDI) was conducted with a selected group of 30 students. Data collected after the IDI were compared with pre-IDI data using a paired-sample t-test.

The study's findings revealed that certain factors significantly influenced student learning performance. Specifically, learning motivation, behavioral engagement, cognitive engagement, emotional engagement, agentic engagement, and feedback were found to have a substantial impact on student learning performance. This indicates that emphasizing these factors can improve learning outcomes among students in blended learning for nursing vocational education.

The paired-sample t-test results showed a significant difference in student learning performance between the post-IDI and pre-IDI stages, suggesting that the 14-week Intervention Design Implementation had a positive and significant effect on student learning performance.

5.2 Recommendations

The findings of this study highlight the significance of several factors in improving student learning performance within blended learning frameworks for nursing vocational education. Educational institutions are advised to implement strategies that enhance learning motivation, as it is crucial for student engagement and success. Institutions could achieve this by incorporating personalized learning goals, providing clear career guidance, and recognizing student achievements to sustain motivation over time.

The study also emphasizes the importance of active, cognitive, emotional, and agentic engagement in the learning process. Interactive activities that require active student participation can boost behavioral engagement, while intellectually challenging curricula can enhance cognitive engagement. Emotional well-being should be supported by creating nurturing educational environments that acknowledge and address student emotions. Additionally, fostering agentic engagement through participatory decision-making processes allows students to have a say in their educational journey.

Constructive feedback mechanisms are essential for guiding students and reinforcing desired outcomes. Feedback should be a core component of the teaching and learning process. The design of blended learning courses should also carefully balance online and face-to-face components to maximize their effectiveness in supporting learning goals.

The study's observation of the positive impact of the 14-week Intervention Design Implementation (IDI) suggests that similar interventions could be beneficial if implemented more broadly. It is recommended that such interventions be

tested across various courses and institutions to validate their effectiveness and identify best practices for blended learning.

Finally, educators are crucial to the success of blended learning environments, and ongoing professional development is essential for them to stay current with the latest pedagogical strategies and technological advancements that enhance blended learning.

5.3 Limitations for Future Research

While this study advances our knowledge of the factors affecting student learning performance in blended learning environments, it has several limitations. The sample size for the IDI was relatively small and restricted to a single institution, which may affect the generalizability of the findings. Future research could benefit from a larger, more diverse sample that spans multiple institutions.

Additionally, the study was limited to a single academic term; a longitudinal study could provide deeper insights into the long-term sustainability of the observed effects. The lack of a control group during the IDI phase also limits the ability to establish definitive causal relationships between the interventions and learning outcomes. Future research should incorporate control groups to strengthen these causal links.

Furthermore, incorporating qualitative analyses alongside quantitative data could offer more detailed insights into students' perspectives and experiences in blended learning settings.

Finally, as technology evolves, so too will the tools and platforms used in blended learning. Future studies should investigate how new technologies might influence student engagement and learning outcomes, ensuring that educational practices keep pace with technological advancements. Addressing these limitations will enhance our understanding and effectiveness of blended learning strategies, especially in nursing vocational education.

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