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Development of Problem-Based Learning Management Activities to Enhance the Knowledge, Skills, and Interests of Students

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Abstract

China's elderly population is on the rise, and there is a growing need for improved education for professionals in geriatric health care and management. "Age-Friendly Interior Design" is a mandatory component of the curriculum for students majoring in aged care and management. Problem-Based Learning (PBL) has been introduced as an innovative teaching model. The study aims to achieve several objectives:1) To compare the knowledge, skills, and interests of students after using Problem-Based Learning (PBL) against predefined criteria. 2) To compare the knowledge, skills, and interests of students after using the Traditional Teaching Method against predefined criteria, and 3)To compare the knowledge, skills, and interests of students after using Problem-Based Learning (PBL) and the Traditional Teaching Method. This research engaged students pursuing degrees in geriatric nursing and management at a university in Sichuan, China. It encompassed both a control group consisting of 42 students and an experimental group with 48 students. The findings indicated that both PBL and traditional teaching methods had a positive impact on enhancing students' knowledge, skills, and interests to some extent. Problem-based learning (PBL) was more effective in improving these aspects than traditional methods with a significance level of 0.05.

Keywords: Age-Friendly Interior Design, knowledge, skills, interests, learning management activities, problem-based learning (PBL), traditional teaching method

1. Introduction

According to the National Health Commission (2022), by the end of 2021, China's elderly population aged 60 and above will reach 267.36 million, accounting for 18.9% of the total population. To meet the demand for elderly care professionals, more than 60 vocational colleges in China have opened geriatric health care and management majors. One of the essential courses in this field is "Age-Friendly Interior Design", designed to cater to the specific needs of the elderly within an aging society. Exploring effective teaching methods, developing their expertise, and nurturing their interest in learning are all crucial aspects, especially for a new major. In 1969, Problem-Based Learning (PBL) was introduced by Howard Barrows, a neurobiology professor at McMaster University in Canada. With the guidance of teachers, this teaching approach is centered around students, focusing on problem-solving, active learning, group discussions, and analysis (Savery, 2006).

1.1 Age-Friendly Interior Design

"Age-Friendly interior design" mainly refers to the corresponding design made in residential, hospitals, shopping malls, and other public buildings according to the physiological and behavioral characteristics of the elderly, to meet the requirements of the elderly in their daily life and activities. The age-appropriate design adheres to the principle and thought of "taking the elderly as the foundation", thinking and analyzing from the perspective of the elderly physiology, psychology, and behavior, to solve the difficulties encountered by the elderly in their daily lives.

1.2 Teaching Method Consisting of Two Methods

Method 1: Traditional Teaching Method is the class teaching system (Tang, 2018). Teachers simultaneously teach students with similar knowledge and understanding, and repeated learning and repeated practice are considered to be the best methods (Lu, 2007). In the context of the "Age-Friendly Interior Design" course, it refers to systematic teaching where teachers explain design norms and cases, with students observing and imitating to grasp basic knowledge and skills. The approach is teacher-centered, focusing on imparting knowledge in a classroom setting. However, it tends to prioritize knowledge over skill development and lacks interactive learning. The teacher's role is central, and students' active participation is limited.

Method 2: Problem-Based Learning (PBL) Method, the Illinois Mathematics and Science Academy (IMSA) defined the PBL teaching method as: Based on the design of problems, students make different judgments and solve problems within their thinking; Teachers treat them differently and assist them to guide them, to open up students' thinking and improve teaching quality in the exchange of teacher-student roles (Gao, 2020). There are two main theoretical bases of PBL, namely, Dewey's pragmatic theory and Swiss psychologist Piaget's constructivism theory. Experimentalism stresses hands-on learning for practical experience (Dewey,1916; Sikandar,2016). Piaget's theory highlights guiding students to construct new experiences (Piaget,1976; Glassman, 2001). This teaching method can combine boring theories with specific learning situations, which is conducive to students' construction of their knowledge system, easy to memorize knowledge, and cultivate the ability, to improve teaching quality.

1.3 Knowledge, Skills, and Interests of Students

Traditional knowledge-learning goals are not connected with real problem situations in real life and are goals divorced from practice (Wang, 2011). The main scope of Student Knowledge referred to in this paper is to analyze the physiological and psychological characteristics of the elderly and find out the commonality of needs, to make the housing design more in line with the actual needs of the elderly (Zhan & Wang, 1982). the physiological characteristics of the elderly need for age-appropriate interior design are mainly divided into four aspects: the demand for a light environment, the demand for a sound environment, the demand for a thermal environment, and the demand for a barrier-free environment. The psychological characteristics of the elderly for the needs of the elderly interior design can be summarized as creating a sense of comfort, enhancing the sense of security, creating interpersonal needs, and protecting the privacy of the elderly. When people enter old age, the size and behavior scale of the body will change, and the living space of the elderly should pay attention to the design of the behavior scale of the elderly to meet the special behavior of the elderly Scale needs (Zhang, 2019).

The skill of students referred to in this paper is to carry out the age-appropriate transformation of the home environment of the elderly according to actual cases. Generally, there are five aspects to be considered, namely, functional design principle, barrier-free design principle, safety design principle, comfort design principle, and personalized design principle. Based on the physiological and psychological characteristics of the elderly in the title cases, as well as the functional requirements of the interior space, students can complete the barrier-free design scheme of the elderly living environment by designing the functional zoning of the interior space, indoor lighting, indoor furniture and furnishings, and indoor size requirements, to optimize the living environment and improve the quality of life of the elderly.

Interest is a subjective cognition, whose motivation is to explore the demand for things, an important factor in promoting a person to discover, understand, and learn the most critical factor in a person's study and life, and a positive emotional expression in line with the social trend（Li, 1997）. If students can stimulate the internal motivation of learning, they will take the initiative and even enjoy learning. Through literature research, it is known that PBL was first applied to medical education and foreign language and literature teaching, and later widely applied to the teaching of various subjects in basic education. In recent years, although PBL has been applied in the design of courses, it is mainly used to improve students' knowledge, skills, and learning interests. However, the course "Age-Friendly Interior Design" lacks practical research. Hence, it is essential to explore both traditional teaching methods and a Problem-Based Learning (PBL) approach for the "Age-Friendly Interior Design" course at college. The aim is to enhance students' knowledge, skills, and interest in learning.

2. Method

2.1 Samples

For the experiment, two classes were chosen through cluster random sampling. All students from Class 1 and Class 2 in the Geriatric Health Care and Management major of the 2022 grade were selected. Using random assignment, class 1 followed the Traditional Teaching Method, with 42 students, while class 2 served as the experimental group using Problem-Based Learning (PBL), consisting of 48 students. A total of 90 students participated in the experiment, comprising 22 boys and 68 girls. Both classes received instruction for eight weeks, totaling 16 class hours.

2.2 Research Instruments

2.2.1 Teaching Process Design

There are two Teaching methods used in this study, namely PBL and Traditional Teaching Methods.

(Under the premise of controlling other teaching conditions, the teaching situation of the experimental class and the control class are compared.)

Table 1. The PBL teaching process design for the Experimental Group (Method 1) and the traditional teaching process design for the Control Group (Method 2), outline the respective procedures

PBL teaching process design (Experimental Group) (Method 1)	**Traditional teaching process design (Control Group) (Method 2)**
1. According to the teaching content of each class, the teacher needs to prepare before class, create scenarios, and raise questions according to the content of this class.	1. After teaching the theoretical knowledge according to the teaching content, the students complete the design result homework.
2. Questions are raised in class, and students are randomly formed into a study group of 5-6 people to make the design result homework.	2. After the homework is handed in, the teacher gives guidance and feedback according to the student's homework.
3. Group members analyzed the problems in class, made plans and division of labor, and searched for relevant materials. The teacher supervised and guided, timely guided, and answered questions.	3. Students modify the design result homework again with the teacher's guidance.
4. Each study group made a report (through ppt, etc.), and the other study group listened carefully.	4. The teacher corrects and evaluates after class.
5. Finally, we need to evaluate the design results according to the report of the study group. The evaluation content generally includes three aspects, namely, the teacher's evaluation of the students, the student's self-evaluation, and the mutual evaluation between the groups.	

2.2.2 A Test of Theoretical Knowledge

To assess students' grasp of "Age-friendly Interior Design" theoretical knowledge, we scheduled an evaluation one week after both the control and experimental classes completed their 8-week learning sessions. During this assessment, we organized both sets of students to simultaneously take a closed-book paper exam. This exam consisted of identical test papers, totaling 100 points, with a duration of 60 minutes. Before distributing the exam papers, we randomly allocated them to 39 students who had previously completed the "Age-friendly Interior Design" course in the prior academic year. We evaluated the test paper's difficulty and differentiation based on data gathered in a pre-survey. The calculated P value was 0.72, and the D value was 0.51. These results indicate that the test paper exhibited moderate difficulty and effective differentiation, rendering it suitable for assessing students' theoretical knowledge attainment.

2.2.3 Scoring Rubric for the "Age-Friendly Interior Design"

The researchers assessed the skill level of the students. The assessment type was case analysis questions, and the assessment content required the students to design a design plan according to the needs of the elderly in the case of the living environment. Regarding Montgomery (2000), a Scoring Rubric for Age-Friendly Interior Design solutions was developed to score design solutions. The total score for the skills test is out of 20 points. Using SPSS 23.0 to calculate Cronbach's $\alpha=0.843$, $\alpha > 0.8$ are obtained, indicating that Scoring Rubrics have good internal consistency and high stability. KMO=0.762, KMO > 0.7 indicates appropriate < 0.05 indicates reasonable structure. According to the data analysis of the pre-survey, Scoring Rubric for the Age-Friendly Interior Design solutions has high consistency and stability, which is suitable for large-scale development and use.

2.2.4 Student Interest Questionnaire Survey for the "Age-Friendly Interior Design"

The questionnaire was designed in a 5 Linkert-scale design. A total of 20 questions are included， the total value is 100 points. Cronbach's $\alpha = 0.991$, KMO= 0.763 ($P<0.05$), indicating that the questionnaire was reasonably structured and highly stable, and could be used for formal data collection.

2.2.5 Data Analysis

Evaluate the normal distribution of each set of data and select the appropriate data analysis method. The researchers utilized a single-sample t-test to analyze the knowledge and skill scores of students in two classes: one taught using the traditional teaching method and the other using the PBL teaching method. This analysis involved examining the mean and standard deviation of scores. If the average knowledge score falls below 70%, it indicates that the requirements have not been met. Similarly, if the skill score is below 14 (out of 20), it signifies a failure to meet the requirements. To assess students' interest levels, the researchers utilized a single-sample Wilcoxon Sign Rank test. They employed total mean and standard deviation values obtained from a five-point Likert scale. On this scale, an interest level of 90 or above signifies a very high level of interest. Scores between 80 and 89 indicate a high level of interest. A range of 70 to 79 represents a moderate level of interest, while a score between 60 and 69 suggests a lower level of interest. Scores falling below 60 indicate the lowest level of interest. The researchers performed both a two-independent-sample t-test and a two-independent-sample Mann-Whitney U-test to ascertain which teaching method resulted in greater enhancements in students' knowledge, skills, and interests. A significance level of $P \leq 0.05$ was used to determine whether the observed differences were statistically significant.

3. Results

The study aims to achieve several objectives: 1) To compare the knowledge, skills and interests of students after using Problem-Based Learning (PBL) against predefined criteria (70 % of 100 Total Score), 2) To compare the knowledge, skills, and interests of students after using the Traditional Teaching Method against predefined criteria(70 % of 100 Total Score), and 3) To compare the knowledge, skills and interests of students after using Problem-Based Learning (PBL) and the Traditional Teaching Method.

3.1 Student Knowledge Test Results

Regarding student knowledge, three research hypotheses can be stated as follows:

(1) Students' knowledge, after receiving instruction through the Problem-Based Learning (PBL) approach (Experimental Group), surpasses the predefined criteria (70% of the total score, equivalent to 70 points).

(2) Students' knowledge, after being instructed using the Traditional Teaching Method (Control Group), exceeds the predefined criteria (70% of the total score, equivalent to 70 points).

(3) Students' knowledge, following instruction with the Problem-Based Learning (PBL) approach (Experimental Group), is superior to that of the Traditional Teaching Method (Control Group).

Before testing those research hypotheses with the t-test, the researchers tested the normal distribution of students' knowledge test results by SPSS 23.0. The one-sample Kolmogorov-Smirnov test is employed to compare the cumulative frequency distribution of the sample data with a normal distribution. If the disparity between the two is minimal, it suggests that the sample is drawn from a population that follows a normal distribution pattern. In our calculations, we found that the p-value for the experimental group is 0.078, and for the control group, it's 0.101. Both of these values exceed 0.05, confirming that the data in both groups conforms to the conditions of a normal distribution (See Table 2). By using a single-sample t-test, the experimental group had a mean score of M1=81.60, and the control group had a mean score of M2=75.43. Both groups exceeded the predefined score of 70 points, indicating that both PBL and traditional teaching methods effectively improved students' knowledge levels (See Table 3 and Table 4). By conducting a two-independent-sample t-test, it revealed that the post-test scores of the experimental group (M1=81.60, SD1=9.444) were greater than those of the control group (M2=75.43, SD2=8.643) with a significance level of 0.05 (p-value = 0.001< 0.05) (See Table 5).

Table 2. The results of normal distribution testing of Knowledge Scores from Method 1 (PBL Method) and from Method 2 (Traditional Teaching Method) by using the Kolmogorov-Smirnov Test

Teaching Methods	Statistics	df	Sig.(p-value)
Method 1 (PBL Method)	.121	48	.078 > 0.05
Method 2 (Traditional Method)	.124	42	.101 > 0.05

Note: Because the Kolmogorov-Smirnov Test for normal distributions of knowledge scores indicates that both the significance values (p-values) obtained from Method 1 (PBL Method) and Method 2 (Traditional Teaching Method) are greater than 0.05, we can conclude that the knowledge scores from Method 1 (PBL Method) and Method 2 (Traditional Teaching Method) follow normal distributions at the 0.05 significance level, respectively.

Table 3. The results of comparing knowledge scores after learning through Teaching Method 1 (Problem-Based Learning (PBL)(Experimental Group) with the predefined criteria (70% of the total score, equivalent to 70 points) using a One-Sample t-test

	Mean (M1)	**Standard Deviation (SD1)**	**Test Value (predefined criteria)**	**p-value =Sig.(1-tailed) =Sig. (2-tailed)/2**
Knowledge Score	81.6042	9.44354	70	000/2=0.000* < 0.05

Note 1: According to the data in Table 3, the one-tailed p-value is 0.000, which is lower than the significance level of 0.05. Consequently, we can infer that students' knowledge, after being taught using the Problem-Based Learning (PBL) (Experimental Group), surpasses the predetermined criteria (70% of the total score, equivalent to 70 points) with a significance level of 0.05.

Note 2: *p-value < .05 (reject null hypothesis)

Table 4. The results of comparing knowledge scores after learning through Teaching Method 2 (Traditional Teaching Method)(Control Group) with the predefined criteria (70% of the total score, equivalent to 70 points) using a One-Sample t-test

	Mean (M2)	**Standard Deviation (SD2)**	**Test Value (predefined criteria)**	**P-value =Sig(1-tailed) =Sig. (2-tailed)/2**
Knowledge Score	75.4286	8.64233	70	000/2=0.000* < 0.05

Note 1: According to the data in Table 4, the one-tailed P-value is 0.000, which is lower than the significance level of 0.05. Consequently, we can infer that students' knowledge, after being taught using the Traditional Teaching Method(Control Group), surpasses the predetermined criteria (70% of the total score, equivalent to 70 points) with a significance level of 0.05.

Note 2: *p-value < .05 (reject null hypothesis)

Table 5. The results of knowledge scores after learning using Teaching Method 1 (Problem-Based Learning - PBL, Experimental Group) and Teaching Method 2 (Traditional Teaching Method, Control Group)

Teaching Method	**Mean**	**Standard Deviation**	**t-test(Equal Variance) (p-value =.805 > 0.05)**	**df**	**p-value(1-tailed) = Sig. (2-tailed)/2**
Problem-Based Learning(PBL) (Experimental Group)(n = 48)	81.6042	9.44354	-3.219	88	.002/2 = 0.001*< 0.05
Traditional Teaching Method)(n= 42) (Control Group)	75.4286	8.64233			

Note 1: According to the data in Table 5, the one-tailed p-value is 0.001, which is lower than the significance level of 0.05. Consequently, we can infer that students' knowledge, after being taught using the Problem-Based Learning (PBL) (Experimental Group) is greater than the Traditional Teaching Method (Control Group) with a significance level of 0.05.

Note 2: *p-value < .05 (reject null hypothesis)

3.2 Student Skill Scoring Rubric Results

Regarding student skills, five research hypotheses can be stated as follows:

(1) Students' skills (in all aspects), after receiving instruction through the Problem-Based Learning (PBL) approach (Experimental Group), surpass the predefined criteria (70% of the 20 total scores, equivalent to 14 points).

(2) Students' skills (in each aspect), after receiving instruction through the Problem-Based Learning (PBL) approach (Experimental Group), surpass the predefined criteria (70% of the 4 total scores, equivalent to 2.8 points).

(3) Students’ skills (in all aspects), after being instructed using the Traditional Teaching Method (Control Group), surpass the predefined criteria (70% of the 20 total scores, equivalent to 14 points).

(4) Students’ skills (in each aspect), after being instructed using the Traditional Teaching Method (Control

Group), surpass the predefined criteria (70% of the 4 total scores, equivalent to 2.8 points).

(5) Students' skills (in all aspects), after receiving instruction through the Problem-Based Learning (PBL) approach (Experimental Group), surpass the Traditional Teaching Method (Control Group).

When evaluating the skills of students, we conducted a case-based skill achievement test one week after both the control and experimental classes had completed eight weeks of learning. The students' task was to create design projects based on the provided case materials. Following the students' presentations and reports, teachers assessed their achievements using a scoring rubric. To assess the normal distribution of students' skill test results, we utilized SPSS 23.0. Employing the one-sample Kolmogorov-Smirnov test, we obtained p-values of 0.055 for the experimental group and 0.059 for the control group. Both of these values exceeded 0.05, confirming that the data from both groups, encompassing all aspects, met the conditions for normal distribution and were suitable for employing the t-test. However, when analyzing each aspect individually, all p-values were less than 0.05, indicating that the data from both groups did not meet the conditions for a normal distribution for the t-test. Consequently, we employed a one-sample Wilcoxon test (see Table 6). After establishing that the skill score data of the students followed a normal distribution, we conducted a one-sample t-test on skill data, considering all aspects in both the experimental and control groups. Simultaneously, we conducted a one-sample Wilcoxon test on skill data for each aspect in both groups. Our skill scoring rubric assesses students' skills across five distinct aspects, with answer options categorized as "Excellent," "Good," "Satisfactory," "Needs Improvement," and "Inadequate," assigned corresponding values of 4, 3, 2, 1, and 0, respectively. In both groups, the student's skill scores across all aspects exceeded the established standards, with the predefined total standard being 14 points (equivalent to 70% of the total score of 20). This significance level was set at 0.05 (p-value < 0.05). Additionally, the skill scores for each aspect individually exceeded the criterion of 2.8 points (representing 70% of the total score of 4) with a significance level of 0.05 (p-value < 0.05) (see Table 7). This demonstrates the effectiveness of both Problem-Based Learning (PBL) and traditional teaching methods in enhancing students' skills (both all aspects and each aspect).

Table 6. The results of normal distribution testing of students' skill scores from Method 1**(** PBL Method**)** and from Method 2 **(**Traditional Teaching Method**)** by using the Kolmogorov**-**Smirnov Test

Aspect	**Group**	**Statistics**	**df**	**Sig.(p-value)**
Functional Design	Experimental Group (n=48)	.297	48	$.000^{*} < 0.05$
	Control Group(n=42)	.333	42	$.000^{*} < 0.05$
Accessibility Design	Experimental Group(n=48)	.350	48	$.000^{*} < 0.05$
	Control Group(n=42)	.333	42	$.000^{*} < 0.05$
Safety Design	Experimental Group (n=48)	.353	48	$.000^{*} < 0.05$
	Control Group(n=42)	.261	42	$.000^{*} < 0.05$
Comfort Design	Experimental Group (n=48)	.317	48	$.000^{*} < 0.05$
	Control Group(n=42)	.315	42	$.000^{*} < 0.05$
Individual Design	Experimental Group(n=48)	.320	48	$.000^{*} < 0.05$
	Control Group(n=42)	.302	42	$.000^{*} < 0.05$
Total	Experimental Group (n=48)	.126	48	.055 > 0.05
	Control Group(n=42)	.133	42	.059 > 0.05

Note 1: Because the Kolmogorov-Smirnov test for normal distributions of skill scores (each aspect) indicates that both the significance values (p-values) obtained from Method 1 (PBL Method) (Experimental Group) and Method 2 (Traditional Teaching Method) (Control Group) are less than 0.05, therefore, the skill scores (each aspect) from two methods do not follow normal distributions at the 0.05 significance level, respectively.

However, the significance values (p-values) obtained for normal distributions of skill scores (all aspects) from the two methods are greater than 0.05, therefore, the skill scores (all aspects) from the two methods follow normal distributions at the level of significance of 0.05.

Note 2: *p-value < .05 (reject null hypothesis)

Table 7. Results of analyzing the student skill score in comparison to criteria (established standards)

Aspect	**Group**	**Total score**	**Criteria**	**Mean**	**SD.**	**Test Statistics**	**p-value = Sig. (1-tailed)**
Functional Design	Experimental (n=48)	4	2.8	3.396	0.61	Z-test for approximation of Wilcoxon test = -5.398	0.000/2= 0.000* < 0.05
	Control (n=42)			3.00	0.58	Z-test for approximation of Wilcoxon test = -2.955	.003/2= 0.0015* < 0.05
Accessibility Design	Experimental (n=48)	4	2.8	3.333	0.56	Z-test for approximation of Wilcoxon test = -5.599	0.000/2= 0.000* < 0.05
	Control (n=42)			3.071	0.60	Z-test for approximation of Wilcoxon test = -3.476	.001/2= 0.0005* < 0.05
Safety Design	Experimental (n=48)	4	2.8	3.5	0.62	Z-test for approximation of Wilcoxon test = -5.573	0.000/2= 0.000* < 0.05
	Control (n=42)			3.167	0.70	Z-test for approximation of Wilcoxon test =-3.529	0.000/2= 0.000* < 0.05
Comfort Design	Experimental (n=48)	4	2.8	3.396	0.57	Z-test for approximation of Wilcoxon test = -5.643	0.000/2= 0.000* < 0.05
	Control (n=42)			3.31	0.60	Z-test for approximation of Wilcoxon test = -4.837	0.000/2= 0.000* < 0.05
Individual Design	Experimental (n=48)	4	2.8	3.438	0.62	Z-test for approximation of Wilcoxon test = -5.463	0.000/2= 0.000* < 0.05
	Control (n=42)			3.143	0.65	Z-test for approximation of Wilcoxon test = -3.678	0.000/2= 0.000* < 0.05
Total	Experimental (n=48)	20	14	17.06	2.18	t- test =9.745	0.000* < 0.05
	Control (n=42)			15.69	1.99	t- test =5.495	0.000* < 0.05

Note: *p-value < .05 (reject null hypothesis)

For testing the 5th research hypothesis, further analysis through the two-independent-sample t-test revealed that the post-test student skill scores of the experimental group (M1=17.06, SD1=2.177) were significantly higher than those of the control group (M2=15.69, SD2=1.994), with a significance level of 0.05(p-value < 0.05) (See Table 8).

Table 8. The results of student skill scores after learning using Teaching Method 1 (Problem-Based Learning - PBL, Experimental Group) and Teaching Method 2 (Traditional Teaching Method, Control Group)

Teaching Method	**Mean**	**Standard Deviation**	**t-test (Equal Variance) (p-value = .711 > 0.05)**	**df**	**p-value(1-tailed) = Sig. (2-tailed)/2**
Problem-Based Learning (PBL) (Experimental Group)(n = 48)	17.06	2.177	-3.101	88	.003/2 = 0.0015* < 0.05
Traditional Teaching Method) (n= 42) (Control Group)	15.69	1.994			

Note 1: According to the data in Table 8, the one-tailed p-value is 0.0015, which is lower than the significance level of 0.05. Consequently, we can infer that students' skills, after being taught using the Problem-Based Learning (PBL) (Experimental Group) were greater than the Traditional Teaching Method(Control Group) with a significance level of 0.05.

Note 2 : *p-value < .05 (reject null hypothesis)

3.3 Student Interests in the "Age-Friendly Interior Design" Course Results

Regarding student interests, four research hypotheses can be stated as follows:

(1) Students' interests (all dimensionalities), after receiving instruction through the Problem-Based Learning (PBL) approach (Experimental Group), surpass the predefined criteria (80% of the 100 total scores, equivalent to 80 points).

(2) Students' interests (all dimensionalities), after being instructed using the Traditional Teaching Method (Control Group), surpass the predefined criteria (80% of the 100 total scores, equivalent to 80 points).

(3) Students' interests (each dimensionality), after receiving instruction through the Problem-Based Learning (PBL) approach (Experimental Group), surpass the Traditional Teaching Method (Control Group).

(4) Students' interests (all dimensionalities), after receiving instruction through the Problem-Based Learning (PBL) approach (Experimental Group), surpass the Traditional Teaching Method (Control Group).

Following the course, all students from both the experimental and control classes participated in a student interest questionnaire survey focused on the "Age-Friendly Interior Design" course. This survey took place on-site and comprised 20 questions. Questionnaires were distributed on-site and collected on-site, with response rates of 100%. Using the one-sample Kolmogorov-Smirnov test, we found that all p-values for the experimental group and the control group were less than 0.05, indicating that both sets of data do not meet the conditions of normal distribution (See Table 9). Because of two sets of data do not conform to the normal distribution, the one sample Wilcoxon Signed-Rank test was used to compare students' interests with the predefined criteria (80 % of 100 Total Score, equivalent to 80 points) both the experimental group and the control group. The results obtained show that p-values for one sample Wilcoxon signed rank test of both classes are less than 0.05, therefore, the students' interests in both classes are higher than the predefined criteria (80 % of 100 Total Score, equivalent to 80 points) with a level of significance of 0.05(See Table10). The results indicate that both the Problem-Based Learning (PBL) teaching method and the traditional teaching method can significantly enhance students' learning interests.

Table 9. The results of normal distribution testing of students' interest scores from Method 1 (PBL Method) and from Method 2 (Traditional Teaching Method) by using the Kolmogorov-Smirnov Test

Dimensionality	**Group**	**Statistics**	**df**	**Sig.(p-value)**
Students' interest in classroom learning	Experimental(n=48)	.281	48	$.000^{*} < 0.05$
Skill learning interest	Control(n=42)	.169	42	$.004^{*} < 0.05$
Student learning initiative	Experimental (n=48)	.387	48	$.000^{*} < 0.05$
	Control(n=42)	.244	42	$.000^{*} < 0.05$
Students' interest in classroom learning	Experimental(n=48)	.368	48	$.000^{*} < 0.05$
Skill learning interest	Control(n=42)	.186	42	$.001^{*} < 0.05$
Student learning initiative	Experimental(n=48)	.202	42	$.000^{*} < 0.05$
	Control(n=42)	.308	48	$.000^{*} < 0.05$
Total	Experimental (n=48)	.271	48	$.000^{*} < 0.05$
	Control (n=42)	.156	42	$.012^{*} < 0.05$

Note 1: Because the Kolmogorov-Smirnov Test for normal distributions of interest scores indicates that both the significance values (p-values) obtained from Method 1 (PBL Method) and Method 2 (Traditional Teaching Method) are less than 0.05, we can conclude that the interest scores (each dimensionality and all dimensionalities) from Method 1 (PBL Method) and Method 2 (Traditional Teaching Method) do not follow normal distributions at the 0.05 significance level, respectively.

Note 2: *p-value < .05 (reject the null hypothesis)

Table 10. Results of analyzing of student interest score in comparison to criteria (predefined criteria)

Group	**Total score**	**Criteria**	**Mean**	**SD.**	**Test Statistics**	**p-value = Sig. (1-tailed)**
Experimental (n=48)	100	80	92.125	10.377	Z-test for approximation of Wilcoxon test = -5.305	0.000/2= $0.000^{*} < 0.05$
Control (n=42)			84.167	12.779	Z-test for approximation of Wilcoxon test = -1.979	.048/2 = $0.024^{*} < 0.05$

Note 1: Based on the data in Table 10, the one-tailed p-value is 0.000, which is less than the significance level of 0.05. This suggests that after being instructed using the Problem-Based Learning (PBL) method in the Experimental Group, interests exceeded the predefined criteria (80% of the 100 Total Score, equivalent to 80 points) with a significance level of 0.05. In the case of the Traditional Teaching Method (Control Group), the one-tailed p-value is 0.024, which is also lower than the significance level of 0.05. Consequently, we can infer that interests, after being taught using the Traditional Teaching Method (Control Group), were greater than the predefined criteria (80% of the 100 Total Score, equivalent to 80 points) at a significance level of 0.05.

Note 2:*p-value < .05 (reject the null hypothesis)

For testing the third and fourth research hypotheses, further analyses through the two-independent-sample Mann-Whitney U-test (or U-test) are employed as shown in Table 11.

Table 11. The outcomes of assessing students' interests in each dimension as well as across all dimensions, following instruction using the Problem-Based Learning (PBL) approach in the Experimental Group and the Traditional Teaching Method in the Control Group

Dimensionality	**Number of questions**	**Total score**	**Mean Rank of Experimental group (n=48)**	**Mean Rank of Control group(n=42)**	**Z-test for approximation of Mann-Whitney U test**	**p-value (1-tailed test)**
Students' interest in classroom learning	6	30	51.97	38.11	-2.583	.010/2= .005*<.05
Skill learning interest	3	15	52.53	37.46	-2.970	.003/2= .0015*<.05
Student learning initiative	6	30	52.94	37.00	-3.085	.002/2= .001*<.05
Extracurricular learning enthusiasm	5	25	52.44	37.57	-2.839	.005/2= .0025*<.05
Total	20	100	52.99	36.94	-2.955	.003/2= .0015*<.05

Note 1: According to the data in Table 11, all of the one-tailed p-values are lower than the significance level of 0.05. Consequently, we can infer that students' interests, after being taught using the Problem-Based Learning (PBL) (Experimental Group) were greater than the Traditional Teaching Method(Control Group) with a significance level of 0.05.

Note 2:*p-value < .05 (reject the null hypothesis)

4. Discussion

The findings indicate that both Problem-Based Learning (PBL) and traditional teaching methods are effective in enhancing students' knowledge, skills, and interests. Furthermore, the experimental group, which received PBL instruction, demonstrated higher levels of knowledge, skills, and interests compared to the control group taught using the traditional method. These results affirm that the utilization of Problem-Based Learning (PBL) significantly fosters students' knowledge and skill development, along with enhancing their learning interest. This approach aids students in acquiring knowledge, and accumulating experience in "Age-Friendly Interior Design," boosting their enthusiasm for learning and cultivating active learning capabilities.

In China, a significant portion of the elderly population opts for home care. Therefore, it becomes crucial to focus on the interior design of housing for the elderly to ensure that their living spaces cater to their daily needs effectively (Pang & Chen, 2023). For students majoring in geriatric health care and management, this course equips them with the skills to design elderly-friendly homes, taking into account the physical and mental well-being of the elderly. This approach aligns with the unique requirements of elderly individuals and enhances their adaptability. Consequently, "Age-Friendly Interior Design" is an essential course for students in this major (Wang, Zou, Liao, & Cai, 2023), enabling them to apply this knowledge in their future careers proficiently. The theoretical foundation of Problem-Based Learning (PBL) is rooted in constructivist theory, emphasizing the integration of learning with real-world situations (Chermack & Van Der Merwe, 2003). Within the problem-oriented teaching model, instructors pose practical questions grounded in real-life scenarios. When students grapple with these genuine problems, they take the initiative to seek information, construct a new knowledge framework, and devise solutions. This approach cultivates students' analytical and problem-solving skills, fostering a sense of engagement within specific learning situations. By merging theoretical concepts with practical scenarios, students can effectively build their own knowledge systems. This method aids in the retention of knowledge and the development of practical skills, ultimately enhancing the overall quality of education.

During the teaching practice, Problem-Based Learning (PBL) typically involves grouping students together. These groups then engage in discussions and report on various milestones throughout the course, ensuring a seamless connection between summaries and the design progress, ultimately resulting in comprehensive design solutions. Beyond traditional teacher evaluations, cooperative learning groups engage in a self-assessment process. Group members provide feedback and grade the reports submitted by their peers. In the context of problem-oriented learning activities, teachers have the opportunity to establish an evaluation scale and instruct students on its completion before the teaching process begins. It's important for teachers to employ diverse evaluation methods to obtain a more well-rounded and objective assessment of student performance (Zhang, Zhang, & Sun, 2023).

Table 12. The roles and activities of teachers and students in the Problem-Based Learning (PBL) process

Activities of teachers	**Activities of students**
Ask questions and show pictures to get students thinking	Positive Thinking
1. The teacher randomly divides the students into 8 groups with 6 students in each group through the "Learning App" and decides on the group leader. 2. Provide related books and Internet resources for students to search and learn. Guide students to design their own solutions to problems. 3. Tour guide, answer students' questions, but do not directly tell students the answer.	1. Determine the division of labor for each student in the group; 2. Make use of the learning resources provided by the teacher to analyze problems, cooperate in learning, search for information, and fully communicate and discuss; 3. Integrate and collect the information together to complete the bathroom design plan, and make a report ppt.
4. The teacher distributes the students' self-evaluation form and the group mutual evaluation form; Ask the students in the study group to submit the design plan and report it in class; The teacher listens to the report and takes notes.	1. Send 1-2 students in the group to the platform to report the design plan, explain their own group's views and consideration direction, and show it through ppt; 2. Members of their own group will shoot a video report on the stage, and supplement immediately if any problem is missed; 3. Other team members listen carefully and take notes.
5. According to the design plan presented by each group of students, combined with the performance of each group of students in the process of learning and discussion, the teacher gave comments one by one; 6. Positive attitude towards learning, serious thinking, through independent learning and group cooperation can be more successful in the completion of the design of the team to give recognition and encouragement; 7. To give guidance to the team that lacks in completing the design scheme. 8. Finally, according to the teaching objectives of this lesson, the teacher summarized the key points and emphasized the difficulties.	Each group member will conduct self-evaluation and mutual evaluation between groups.

5. Conclusion

Through the implementation of the PBL teaching method and traditional teaching method, this study formulated the corresponding teaching plan and implemented it in a college of China for students majoring in geriatric and health management. The experiment included two groups, namely the experimental group and the control group. Data analysis and research were carried out by collecting students' scores on theoretical knowledge, skills and interests in learning. The findings indicate that both PBL and traditional teaching methods have a positive impact on enhancing students' knowledge, skills, and interests to some extent. The findings indicate that both PBL and traditional teaching methods have a positive impact on enhancing students' knowledge, skills and interests to some extent. Problem-based learning (PBL) is more effective in improving these aspects than traditional methods.

During the implementation of Problem-Based Learning (PBL) , it becomes evident that students exhibit a higher level of interests in the classroom. Hence, teachers have the flexibility to select appropriate teaching methods based on subject attributes, teaching content, and the learning context of their students. In practical teaching, educators should bravely experiment with diverse teaching techniques and consistently reflect on and enhance their interaction with students. This approach benefits not only students' development but also elevates the teaching proficiency of educators themselves.

In the process of Problem-Based Learning (PBL), creating problem scenarios to let students solve problems and complete assigned tasks is the focus of the teaching process. When creating problem scenarios, teachers should consider students' actual life experiences and design questions that meet the real situation. For example, in the course "Age-Friendly Interior Design", teachers can ask students questions based on the actual cases of the living environment of the elderly. In the process of PBL learning, a very important link is the collection of student data. Therefore, before class, teachers should prepare some relevant knowledge materials, or organize relevant website materials for students to use. It also teaches students practical search skills and improves students' knowledge and skills.

When students are engaged in PBL tasks, it's crucial for teachers to adeptly manage the pace of the classroom in line with the student's actual progress in solving problems. This involves granting students ample time for reporting and discussion. While teachers should refrain from excessive intervention in student discussions, they should also step in to provide guidance and insight when necessary. Achieving this balance necessitates teachers to possess a strong foundation in curriculum expertise and PBL teaching skills. Only by effectively and scientifically managing classroom dynamics can we attain our teaching objectives and realize anticipated educational outcomes.

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