The Research on the Interaction Between Learning Power and Learning Outcomes of Engineering College Students Under the Background of China Engineering Education Accreditation

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Abstract

This paper focuses on the intricate interaction between learning power and learning outcomes among engineering college students within the context of China's Engineering Education Accreditation. The study aims to explore : 1.the role of learning power on learning outcomes from the perspective of learning power system, adjustment power system, behavior power system and support power system by comparing the influence degree of different factors; 2.various strategies that can effectively improve the level of college students' learning power. The sample were 517 junior and senior undergraduate students from engineering universities. They were selected by the questionnaire investigation,the research instrument for the data collection were SoJump. The statistics for data analysis were carried out by descriptive statistical analysis, correlation analysis and regression analysis with SPSS 25.0, to determine the degree of correlation between each element and learning outcome according to the correlation coefficient and significance level. The research results were found as follows: 1.The mean ranking of each factor of engineering students' learning power from high to low is power system, support force system, behavior force system and adjustment force system respectively; 2. The scores of senior students in learning power and learning outcomes are significantly higher than those of junior students, and the scores of CPC members (including probationary party member) in learning power and learning outcomes are significantly higher than those of Communist Youth League members and the masses. The scores of students who have participated in discipline competitions are significantly higher than those without participating in discipline competitions, and the scores of students who have participated in teacher's project research or interest group are significantly higher than those without participating in teacher's project research or interest group；3.There is a significant positive correlation between the motivation power system, behavior power system, adjustment power system and support power system system of learning power and the learning outcomes.the paper suggests that we can effectively improve the learning outcomes of engineering students through stimulating students' learning interest, rationally arranging learning time, providing quality teaching resources, strengthening psychological counseling and support, and cultivating students' self-regulation ability.

Keywords: Engineering Education; Learning Power; Learning Outcomes

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Introduction

At present, the whole world is facing a profound systemic change, a new round of technological revolution and industrial transformation is advancing by leaps and bounds. The generation, deepening and dissemination of innovation are significantly accelerated, the shapes of various fields are also being reshaped, and the emergence of new technologies, new forms of business, new models of higher education put forward higher requirements. Education is an important field which has been widely affected by changes. Education itself should not only make forward-looking adjustments with changes, but also help students prepare for future jobs that cannot be accurately defined, and respond to the "transformation question" of national economic development. Anlei and Binglin, (2020: 65) discussed the situation, problems and paths of training first-class engineering and technical talents, and mentioned that in order to adapt to the new trend of the new round of scientific and technological revolution and industrial transformation, institutions of higher learning all over the world are taking active actions to systematically adjust the structure of higher education and formulate and implement engineering education reform strategies to meet the urgent demand for technical talents in the global market. For example, Germany's requirements for "Industry 4.0" continue to increase investment in engineering education, the "Europe 2020 strategy" clearly proposes to promote engineering education cooperation among EU countries, and the United Kingdom has promulgated a national skills strategy. Faced a new wave of technological revolution and industrial transformation, China urgently needs to focus on the urgent needs of the country and long-term development needs, cultivate outstanding engineering talents for the future, bravely shoulder the heavy responsibility of The Times, and accelerate the promotion of engineering innovation and technology. Therefore, how to cultivate the engineers of diversity and innovation who can meet the challenges of the future and adapt to the needs of economic development in the new era is an urgent issue faced by the colleges and universities.

Yingqiu Yi et al, (2023: 337) discussed the significance and path cultivation of college students' lifelong learning power from the perspective of new engineering, and proposed that learning power is the core element to help engineering students adapt to the growth of individual life and career development in the new era, which should be the focus point of the promoted and deepened reformation of "new engineering" education. According to the previous theoretical combing and construction, learning power not only contains the psychological concepts such as learning motivation, learning attitude and learning perseverance, but also includes the behavioral content such as learning methods, learning strategies and learning management, which has a wide breadth and a high degree of comprehensive concepts (Wang, 2023: 25),which is the integrated embodiment of one’s learning motivation, perseverance and the power (King & Kitchener, 1994). Learning power mainly includes the key issues such as why learners learn, how to learn and whether the learner is willing to learn. From the perspective of power view, this study suggests that learning power is a comprehensive system composed of various force factors that can support learners' continuous learning and improve their learning outcomes in the process of learning, including Motivation power system, Adjustment power system, Behavior power system and Support power system (He, 2013: 106). Motivation power system involves students' willingness to learn, presented as "desire of learning", is the internal driving force to carry out learning behavior, including learning motivation, learning interest, learning attitude and learning perseverance. The adjustment power system is manifested as "capability of learning", showing that students timely and appropriately adjust learning activities based on self-cognition and correct assessment, so as to achieve the best learning effect, including goal setting, self-monitoring and assessment adjustment. The performance of behavior power system is "ability of learning", which reflects the learning ability of students based on cognition, including knowledge acquisition, knowledge understanding, knowledge transformation and knowledge innovation. The support system is manifested as the problem of "possibility of learning ", which is the guarantee condition to support students' continuous learning, mainly including the support from the school, teachers and classmates. The four systems are closely related and work together on the learning power of students.

In recent years, tremendous changes have taken place in the field of engineering education, one of which is the shift from the traditional teacher-centered and knowledge-oriented engineering education to the student-centered, ability-oriented and learner-oriented Outcome-Based Education (OBE) education (Shaeiwitz, 1996: 239). That is, more attention should be paid to students' learning outcomes upon graduation (Froyd, Wankat & Smith 2012: 1344). Accreditation Board for Engineering and Technology (ABET)defines the students' learning outcomes as the skills, knowledge and behaviors that students are expected to master before graduation through professional learning (Dan, 2015: 7). In 2022, China Engineering Education Accreditation Association (CEEAA) defined learning outcomes as the specific description of the knowledge and ability that students should master at the time of graduation, including the knowledge, ability and quality that students have mastered after learning, and put forward 12 graduation requirements. This study takes the graduation requirements of engineering students as the test standard for learning outcomes, aims to explore the interaction between various factors in the learning power that affect the learning outcomes of students, and how each factor in the learning power affects the learning outcomes, so as to propose specific paths to improve the learning outcomes of students in engineering colleges and universities, and expand the depth of engineering education talent training, injecting vitality into the research related to the higher education and higher engineering education in our country.

In conclusion, faced with the high-quality development of new engineering education in the future, the cultivation of lifelong learning power of engineering students is not only related to the development needs of the social dimension of professional identity of future engineers, but also related to the value demands of lifelong growth of the subject dimension.. Therefore, the training of learning power should become the origin of the high-quality development and reform of application-oriented undergraduate education. So this study aims to explore the interaction between various factors in the learning power that affect the learning outcomes of students, and how each factor in the learning power affects the learning outcomes, so as to propose specific paths to improve the learning outcomes of students in engineering colleges and universities, and expand the depth of engineering education talent training, injecting vitality into the research related to the higher education and higher engineering education in our country.

Research Objective

1.To conduct a survey and analyze questionnaires regarding the learning power and learning outcomes of engineering students.

2.To understand the relationship between learning power

3.To the learning outcomes of engineering students This facilitates the scientific evaluation of the learning outcomes of engineering students. and promoting the development of engineering talent for the better.

Research Scope

This study adopts convenient sampling and conducts an online survey of students in Xinxiang area of Henan province through the questionnaire Star platform. It takes about 7 minutes to complete the questionnaire. 540 questionnaires were sent out, 532 were recovered, 15 unqualified questionnaires were proposed, such as the completion time of the questionnaire was less than 100s, random answers and obvious data errors, and 517 valid questionnaires were obtained, with an effective rate of 95.74%. Among them, 330 are juniors (63.83%), 187 are seniors (36.17%), 456 are boys (88.20%), and 61 are girls (11.80%). Other demographic variables are shown in Table 1.

Table 1 Statistical Table of Sample Population Variables

Variables	Classification	Frequency	Percentage(%)
Major	Mechanical Design, Manufacturing, and Automation	159	30.8
	Electrical Engineering	151	29.2
	Automotive Engineering	96	18.6
	Cable Engineering	100	19.3
	other	11	2.1
Gender	Male	456	88.2
	Female	61	11.8
Grade	Junior	330	63.8
	Senior	187	36.2
Political Outlook	Communist Party members (including probationary members)	72	13.9
	Communist Youth League members	365	70.6
	masses	80	15.5
Whether to Participate Subject Competitions	yes	165	31.9
	no	352	68.1
Whether to participate in project research or interest groups	yes	124	24
	no	393	76

Research Methodology

1. Source of Data :The data for this research was collected from the target population of engineering college students through through testing and questionnaire with questionnaire collection software “SoJump” .

2. Population and Sampling :The population for this study consisted of 517 junior and senior undergraduate students from Henan Institute of Technology, one of engineering universities, established in 1975. A stratified handy sampling technique was employed to ensure representation from different backgrounds, years of study, and engineering disciplines. allowing for a more diverse and representative sample, and enhancing the validity and reliability of the findings.

3. Data Collecting :Data collection was conducted from questionnaires and surveys , distributed to the sampled students to gather quantitative data on their learning power, including learning motivation, learning behavior,learning adjustment and learning support . Subsequently, the collected data was entered into a data processing software SPSS for further analysis.

4. Analysis of Data：SPSS 25.0 software was used to conduct correlation analysis to determine the strength and direction of the correlation between different variables. A regression analysis was performed to determine how learning-related factors affect learning outcomes and to estimate the strength of this effect. Difference analysis (such as independent sample t test or ANOVA)was conducted to compare the differences between different groups (such as different genders, age groups, etc.) in learning power related factors and learning outcomes.

5. Research Methodology:

1）Literature research was adopted to explore the factors of learning power through the collection, sorting, classification and reading of literature related to the theory of college students' learning power and its influencing factors to;

2）Quantitative research was carried out with the compiling and distribution of questionnaires through random sampling, aims to collect and analyze data related to learning power.

2.1 Learning Power Questionnaire Scale

The learning power questionnaire is self-designed and Likert 5-point scoring method is adopted, with 1 representing completely inconsistent and 5 representing completely consistent. The Motivation power system questionnaire adopts the current situation survey scale of secondary vocational students' learning motivation compiled by Hongxiu Zhou (2022: 39), The scale has 15 questions and is divided into four dimensions, including learning motivation, learning interest, learning attitude and learning will. Cronbach'sα in the Motivation power system is 0.966. The Behavior power system questionnaire was used in the current status questionnaire compiled by Anqi Wu, (2021: 42) The questionnaire consisted of 15 questions, including four dimensions of knowledge acquisition, knowledge understanding, knowledge transformation and knowledge innovation. In this study, the Cronbach'sα of the Behavior power system was 0.980. The Adjustment power system adopts questionnaire from the questionnaire on the status of rural teachers' online learning power compiled by Anqi Wu et al. The questionnaire has 10 questions, including three dimensions of goal setting, self-monitoring and assessment adjustment, and the Cronbach'sα of the Adjustment power system is 0.971. Support power system adopts questionnaire from the social support scale (the Perceived Social Support Scale, PSSS) compiled by Zimet, Dahlem and Farley (1988), as the research object of this study is college students, their life and study is close relationship between students, so this study replaces "friend support" with "classmate support". There were 12 items in the scale, including family support, classmate support and family support. The Cronbach's α of the Support power system was 0.963. The reliability results of each system are shown in Table 2.

Table 2 Reliability Test of Learning Power Systems

Variables	Index Quantity	Cronbach's α	Cronbach's α Based on the standardized item	The Whole Cronbach's α
Motivation power system	4	0.966	0.967	0.992
Behavior power system	4	0.980	0.980	
Adjustment power system	3	0.971	0.971	
Support power system	3	0.962	0.963	

2.2 Learning Outcomes Scale

The learning outcomes scale is adapted from the engineering student training plan, with a total of 12 questions. Likert5-point scoring method is adopted, with 1 representing complete non-conformity and 5 representing complete conformity. In this study, Cronbach'sα of learning outcomes was 0.985, indicating that the measurement results of learning outcomes also reached a high reliability level. The reliability results of learning outcomes are shown in Table 3.

Table 3 Reliability Test of Learning Outcomes

Cronbach's Alpha	Cronbachs Alpha Based on Standardized Items	Number of Terms
0.985	0.985	12

2.3 Questionnaire Validity Analysis

SPSS25.0 was used to test the validity of the questionnaire data, and the results were shown in Table 4. The KMO value of the questionnaire is 0.984>0.9, which indicates that it is very suitable for factor analysis. The observed value of Bartlett's spherical test measurement is 51690.456, and its significance is p<.01, indicating that there are common factors among variables rather than contrary ones. It also indicates that there is a high correlation between the sample data in this group, which is suitable for factor analysis.

Table 4 KMO and Bartlett Tests of the Questionnaire

Sample the Kaiser-Meyer-Olkin Measure of Adequacy		**0.984**
Bartlett's Spherical test	Approximate Chi-square	51690.456
	df	2016
	Sig	.000

KMO and Bartlett tests were carried out on each system dimension of learning power, and the results were shown in Table 5. The KMO values of each system dimension are 0.960, 0.968, 0.957 and 0.954 respectively, all of which are greater than 0.9, indicating that they are very suitable for factor analysis. The observed values of Bartlett spherical test measurement are 7937.917, 10329.034, 6235.291 and 6110.300, respectively. Their significance is $p<.01$, indicating that the variables are not opposed to each other, but there are common factors. It also indicates that the correlation between the sample data in this group is high, and it is suitable for factor analysis.

Table 5 KMO and Bartlett Tests for Learning Power Systems

		Motivation Power System	**Behavior Power System**	**Adjustment Power system**	**Support Power System**
KMO		0.960	0.968	0.957	0.954
Bartlett's spherical test	Approximate chi-square	7937.917	10329.034	6235.291	6110.300
	Df	105	105	45	66
	Sig	.000	.000	.000	.000

KMO and Bartlett tests were conducted on learning outcomes, and the results were shown in Table 6. The KMO value of learning outcomes was 0.964>0.9, indicating that it was very suitable for factor analysis. The observed value of Bartlett's sphericity test measurement was 10722.951, and its significance was $p<0.01$, indicating that there were common factors rather than opposites among variables. It also indicated that there was a high correlation between the sample data in this group, which was suitable for factor analysis.

Table 6 KMO and Bartlett Tests of Learning Outcomes

Sample the Kaiser-Meyer-Olkin Measure of Adequacy		**0.964**
Bartlett's Sphericity test	Approximate chi-square	10722.951
	df	66
	Sig	0.000

Research Results

1. Descriptive Statistics and Correlation Analysis

The data and statistics of each system of learning power and learning outcomes are carried out, and the results are shown in Table 7. Pearson correlation analysis results showed that the correlation between Motivation power system, Behavior power system, Adjustment power system, and Support power system is very significant, indicating that there is a significant pairwise correlation between each variable.

Table 7 Descriptive Statistics and Correlation Matrices for Learning Power Systems and Learning Outcomes

Variable	M	SD	Motivation Power System	Behavior Power System	Behavior Power System	Support Power System	Learning Outcomes
Motivation Power System	3.86	0.76	1				
Behavior Power System	3.82	0.79	0.972**	1			
Adjustment Power System	3.82	0.80	0.965**	0.977**	1		
Support Power System	3.86	0.78	0.938**	0.913**	0.898**	1	
Learning Outcomes	3.76	0.80	0.882**	0.881**	0.870**	0.844**	1

** indicates that P<.01 is at the level of 0.01 (double-tailed), and the correlation is significant.

2. Difference Analysis

2.1 Comparison of Differences in Various Variables among Engineering Students of Different Genders

Independent sample T-test was used to analyze the scores of engineering students of different genders in each project, and the results were shown in Table 8. The results showed that there were no significant differences between boys and girls in motivation power system, behavior power system, adjustment power system, support power system and learning outcomes.

Table 8 Independent Sample T Test of Different Gender Engineering Students in Each Variable

Variables	Mean (standard deviation)		t	p	Difference Comparison
	Male	Female			
Motivation Power System	3.87(.77)	3.80(.68)	.644	.521	
Learning Motivation	3.98(.77)	3.94(.70)	.384	.701	
Learning Interest	3.70(.89)	3.60(.78)	.864	.388	
Learning Attitude	3.87(.81)	3.81(.72)	.521	.604	
Learning Will	3.82(.84)	3.75(.76)	.607	.544	
Behavior Power System	3.83(.80)	3.74(.70)	.849	.397	
Knowledge Acquisition	3.86(.81)	3.80(.67)	.570	.570	
Knowledge Understanding	3.80(.84)	3.65(.72)	1.547	.126	
Knowledge Transformation	3.86(.83)	3.65(.72)	.689	.491	
Knowledge Innovation	3.81(.83)	3.73(.73)	.742	.460	
Adjustment Power System	3.83(.81)	3.76(.71)	.633	.527	
Goal Setting	3.76(.87)	3.67(.76)	.791	.430	
Self-Monitoring	3.89(.82)	3.80(.76)	.748	.455	
Assessment Adjustment	3.83(.83)	3.81(.75)	.748	.455	
Support Power System	3.87(.79)	3.81(.67)	.532	.595	
Teacher Support	3.78(.85)	3.68(.75)	1.034	.304	
Classmate Support	3.89(.83)	3.86(.70)	.262	.794	
Family Support	3.92(.80)	3.89(.79)	.337	.736	
Learning Outcomes	3.76(.81)	3.73(.76)	.241	.809	

1= male, 2= female
**. **. At level 0.01 (two-tailed), the independent sample T-test was significant;
*. At level 0.05 (two-tailed), the independent sample T-test was significant.

2.2 Comparison of the Differences of Various Variables among Engineering Students of Different Grades

T test of independent samples was used to analyze the scores of engineering students in different grades in each project, and the results were shown in Table 9. The results show that there are significant differences between junior and senior students in motivation power system, adjustment power System, behavior power system and support power system and learning outcomes. The scores of senior students in motivation system, learning interest, learning attitude, learning will, behavior power system, knowledge acquisition, knowledge understanding, knowledge transformation, knowledge innovation, adjustment power system, goal setting, self-monitoring, assessment adjustment, support power system, teacher support, classmate support and learning outcomes are significantly higher than those of junior students.

Table 9 Independent Sample T Test of Different Grade Engineering Students in Each Variable

Variables	Mean (Standard Deviation)		t	p	Difference Comparison
	Junior	Senior			
Motivation Power System	3.80(.77)	3.97(.72)	-2.455	.014*	1<2
Learning Motivation	3.93(.78)	4.06(.73)	-1.882	.060	
Learning Interest	3.62(.88)	3.81(.85)	-2.407	.016*	1<2
Learning Attitude	3.89(.82)	3.99(.76)	-2.793	.005**	1<2
Learning Perseverance	3.75(.85)	3.94(.79)	-2.621	.009**	1<2
Behavior Power System	3.75(.80)	3.94(.75)	-2.680	.008**	1<2
Knowledge Acquisition	3.78(.81)	3.97(.74)	-2.631	.009**	1<2
Knowledge Understanding	3.71(.84)	3.91(.77)	-2.890	.004**	1<2
Knowledge Transformation	3.79(.83)	3.98(.72)	-2.555	.011*	1<2
Knowledge Innovation	3.74(.83)	3.91(.79)	-2.555	.011*	1<2
Adjustment Power System	3.76(.80)	3.93(.78)	-2.322	.021*	1<2
Goal Setting	3.67(.86)	3.88(.83)	-2.747	.006**	1<2
Self-Monitoring	3.82(.82)	3.97(.81)	-1.976	.049*	1<2
Assessment Adjustment	3.78(.83)	3.93(.81)	-2.023	.044*	1<2
Support Power System	3.67(.87)	3.81(.67)	-2.753	.006**	1<2
Teacher Support	3.67(.87)	3.95(.75)	-3.731	.000**	1<2
Classmate Support	3.82(.83)	4.00(.78)	-2.350	.019*	1<2
Family Support	3.87(.81)	4.00(.75)	-1.716	.087	
Learning Outcomes	3.70(.80)	3.86(.81)	-2.264	.024*	1<2

1= junior, 2= senior
**. At level 0.01 (two-tailed), the independent sample T-test was significant;
*. At level 0.05 (two-tailed), the independent sample T-test was significant.

2.3 Comparison of the Differences of Various Variables among Engineering Students with Different Political Profiles

One-way analysis of variance is used to analyze the scores of engineering students with different political profiles in each project, and the results are shown in Table 10. The results show that CPC members (including probationary party members) have significant differences in motivation power system, adjustment power system, behavior power system,support power system and learning outcomes. The scores of CPC members (including probationary party members) in motivation power system, learning motivation, learning interest, learning attitude, learning will, behavior power system, knowledge acquisition, knowledge understanding, knowledge transformation, knowledge innovation, adjustment power system, goal setting, self-monitoring, assessment adjustment, support power system, teacher support, classmate support, family support and learning outcomes were significantly higher than those of the Communist Youth League members. The scores of CPC members (including probationary party members) in motivation power system, learning motivation, learning interest, learning attitude, learning will, behavior power system, knowledge acquisition, knowledge understanding, knowledge transformation, knowledge innovation, adjustment power system, goal setting, self-monitoring, assessment adjustment, support power system, teacher support, classmate support, family support and learning outcomes were significantly higher than those of the masses.

Table 10 Univariate Analysis of Variance of Different Political Profiles in Each Variable

Variables	**Mean (standard deviation)**			**F**	**p**	**Difference Comparison**
	CPC Members (including Probationary Party Members) N=72	**Communist Youth League Members N=365**	**Masses N=80**			
Motivation Power System	4.16(.63)	3.81(.74)	3.84(.86)	6.438	.002**	1>2,1>3
Learning Motivation	4.28(.57)	3.93(.76)	3.93(.88)	6.945	.001**	1>2,1>3
Learning Interest	4.04(.80)	3.63(.85)	3.64(..97)	6.853	.001**	1>2,1>3
Learning Attitude	4.09(.71)	3.81(.79)	3.87(.90)	3.725	.025*	1>2
Learning Perseverance	4.08(.74)	3.75(.82)	3.85(.92)	4.889	.008**	1>2
Behavior Power System	4.12(.66)	3.76(.78)	3.83(.87)	6.645	.001**	1>2,1>3
Knowledge Acquisition	4.17(.64)	3.78(.78)	3.87(.90)	7.431	.001**	1>2,1>3
Knowledge Understanding	4.13(.71)	3.71(.82)	3.78(.88)	7.889	.000**	1>2,1>3
Knowledge Transformation	4.13(.71)	3.80(.82)	3.89(.92)	4.899	.008**	1>2,1>3
Knowledge Innovation	4.07(.70)	3.75(.81)	3.81(.91)	4.631	.010*	1>2,1>3
Adjustment Power System	4.13(.67)	3.76(.80)	3.87(.84)	6.897	.001**	1>2,1>3
Goal Setting	4.06(.76)	3.68(.86)	3.77(.88)	6.206	.002**	1>2,1>3
Self-Monitoring	4.17(..67)	3.80(.82)	3.96(.87)	6.685	.001**	1>2
Assessment Adjustment	4.14(.69)	3.77(.82)	3.85(.88)	6.244	.002**	1>2,1>3

Support Power System	4.20(.59)	3.80(.77)	3.82(.88)	8.304	.000**	1>2,1>3
Teacher Support	4.12(.69)	3.71(.83)	3.74(.96)	7.341	.001**	1>2,1>3
Classmate Support	4.26(.61)	3.81(.81)	3.87(.90)	9.206	.000**	1>2,1>3
Family Support	4.22(.62)	3.87(.78)	3.86(.89)	6.232	.002**	1>2,1>3
Learning Outcomes	4.01(.72)	3.70(.79)	3.79(.88)	4.487	.012*	1>2,1>3

1= Communist Party members (including probationary members),2= Communist Youth League members,3= the masses
**. At 0.01 level (double tail), ANOVA test was significant;
*. At level 0.05 (two-tailed), ANOVA test was significant.

2.4 Comparison of Differences in Various Variables among Engineering Students Who Have Participated in Discipline Competitions

The t test of independent samples was used to analyze the scores of engineering students in various projects whether they had participated in discipline competitions, and the results were shown in Table 11. The results showed that The scores of the students who participated in the discipline competition were significantly higher than those of the students who did not participate in the discipline competition in motivation power system, learning interest, learning attitude, learning will, behavior power system, knowledge acquisition, knowledge understanding, knowledge transformation, knowledge innovation, adjustment power system, goal setting, self-monitoring, assessment adjustment, support power system, teacher support, classmate support and learning outcomes.

Figure 11 Independent Sample T Test of Engineering Students in Each Variable Whether They Have Participated in Discipline Competitions

Variables	**Mean (Standard Deviation)**		**t**	**p**	**Difference Comparison**
	Yes(N=165)	**No(N=352)**			
Motivation Power System	3.99(.78)	3.80(.74)	2.553	.011*	1>2
Learning Motivation	4.07(.77)	3.93(.76)	1.935	.054	
Learning Interest	3.82(.91)	3.63(.86)	2.348	.019*	1>2
Learning Attitude	4.00(.80)	3.80(.79)	2.651	.008**.	1>2
Learning Perseverance	3.98(.83)	3.74(.83)	3.066	.002**.	1>2
Behavior Power System	3.97(.78)	3.75(.78)	2.920	.004**.	1>2
Knowledge Acquisition	3.97(.79)	3.79(.79)	2.434	.015*	1>2
Knowledge Understanding	3.94(.82)	3.71(.81)	2.963	.003**.	1>2
Knowledge Transformation	4.03(.82)	3.78(.82)	3.275	.001**.	1>2
Knowledge Innovation	3.94(.81)	3.73(.82)	2.696	.007**.	1>2
Adjustment Power	3.96(.79)	3.76(.79)	2.664	.008**.	1>2

System					
Goal Setting	3.86(.86)	3.70(.85)	2.023	.044*	1>2
Self-Monitoring	4.02(.81)	3.81(.81)	2.747	.006**.	1>2
Assessment Adjustment	3.98(.83)	3.76(.81)	2.859	.004**.	1>2
Support Power System	3.96(.82)	3.81(.75)	2.115	.035*	1>2
Teacher Support	3.94(.87)	3.71(.82)	2.545	.011*	1>2
Classmate Support	4.00(.86)	3.83(.79)	2.161	.031*	1>2
Family Support	3.98(.83)	3.89(.77)	1.303	.193	
Learning Outcomes	3.89(.82)	3.69(.79)	2.681	.008**.	1>2

1= participated in discipline competition,2= did not participate in discipline competition;
**. At level 0.01 (two-tailed), the independent sample T-test was significant;
*. At level 0.05 (two-tailed), the independent sample T-test was significant.

2.5 Whether or Not Have Participated in the Teacher's Project Research or Interest Group and Compared the Differences in Various Variables

The independent sample T-test was used to analyze the scores of various items in teachers' research projects or interest groups, and the results were shown in Table 12. The results showed that The scores of the students who participated in the discipline competition were significantly higher than those without participation in the teacher's project research or interest group in motivation power system, learning motivation, learning interest, learning attitude, learning will, behavior power system, knowledge acquisition, knowledge understanding, knowledge transformation, knowledge innovation, adjustment power system, goal setting, self-monitoring, assessment adjustment, support power system, teacher support, classmate support, family support and learning outcomes.

Table 12 Independent sample T Test of Engineering Students in Each Variable Whether They have Participated in the Teacher's Project Research or Interest Group

Variable	**Mean (Standard Deviation)**		**t**	**p**	**Difference Comparison**
	Yes(N=124)	**No(N=393)**			
Motivation Power System	4.08(.73)	3.80(.76)	3.632	.000**	1>2
Learning Motivation	4.07(.77)	3.93(.76)	3.306	.001**	1>2
Learning Interest	3.97(.87)	3.60(.86)	4.122	.000**	1>2
Learning Attitude	4.06(.77)	3.80(.80)	3.284	.001**	1>2
Learning Perseverance	4.01(.82)	3.75(.83)	2.982	.003**	1>2
Behavior Power System	4.05(.77)	3.75(.78)	3.766	.000**	1>2
Knowledge Acquisition	4.10(.77)	3.77(.79)	3.981	.000**	1>2
Knowledge Understanding	4.02(.82)	3.71(.81)	3.743	.000**	1>2
Knowledge Transformation	4.08(.80)	3.78(.82)	3.550	.000**	1>2
Knowledge Innovation	4.00(.81)	3.73(.81)	3.243	.001**	1>2

Adjustment Power System	4.03(.79)	3.76(.79)	3.405	.001**	1>2
Goal Setting	3.95(.88)	3.68(.84)	3.070	.002**	1>2
Self-Monitoring	4.09(.79)	3.81(.81)	3.321	.001**	1>2
Assessment Adjustment	4.05(.82)	3.76(.81)	3.397	.001**	1>2
Support Power System	4.05(.77)	3.80(.77)	3.196	.001**	1>2
Teacher Support	4.00(.83)	3.70(.83)	3.487	.001**	1>2
Classmate Support	4.08(.84)	3.83(.80)	3.023	.003**	1>2
Family Support	4.08(.79)	3.87(.78)	2.591	.010*	1>2
Learning Outcomes	3.98(.77)	3.69(.80)	3.585	.000**	1>2

1= have participated in the teacher's project research or interest group,
2= did not participate in the teacher's project research or interest group;
**. At level 0.01 (two-tailed), the independent sample T-test was significant;
*. At level 0.05 (two-tailed), the independent sample T-test was significant.

2.6 Comparison of Differences of Household Residence in Each Variable

Independent sample T-test was used to analyze the scores of students whose families live in various items, and the results were shown in Table 13. The results showed that students living in urban areas scored significantly higher on both support power system and family support than students living in rural areas.

Table 13 Independent Sample T-test of Household Residence in Each Variable

Variables	Mean (Standard Deviation)		t	p	Difference Comparison
	Urban(N=132)	Rural(N=393)			
Motivation Power System	4.07(.78)	3.94(.75)	1.342	.180	
Learning Motivation	4.07(.77)	3.93(.76)	1.648	.100	
Learning Interest	3.97(.87)	3.60(.86)	1.232	.218	
Learning Attitude	4.06(.77)	3.80(.80)	.980	.327	
Learning Perseverance	4.01(.82)	3.75(.83)	.811	.419	
Behavior Power System	4.05(.77)	3.75(.78)	1.333	.183	
Knowledge Acquisition	4.10(.77)	3.77(.79)	1.714	.087	
Knowledge Understanding	4.02(.82)	3.71(.81)	1.476	.141	
Knowledge Transformation	4.08(.80)	3.78(.82)	.937	.350	
Knowledge Innovation	4.00(.81)	3.73(.81)	.914	.361	
Adjustment Power System	4.03(.79)	3.76(.79)	1.491	.136	
Goal Setting	3.95(.88)	3.68(.84)	1.927	.055	
Self-Monitoring	4.09(.79)	3.81(.81)	1.365	.173	
Assessment Adjustment	4.05(.82)	3.76(.81)	1.007	.315	

Support Power System	4.05(.77)	3.80(.77)	2.054	.040*	1>2
Teacher Support	4.00(.83)	3.70(.83)	1.652	.099	
Classmate Support	4.08(.84)	3.83(.80)	1.908	.057	
Family Support	4.08(.79)	3.87(.78)	2.330	.020*	1>2
Learning Outcomes	3.98(.77)	3.69(.80)	1.909	.057	

1= urban,2= rural;；
**. At level 0.01 (two-tailed), the independent sample T-test was significant；
*. At level 0.05 (two-tailed), the independent sample T-test was significant.

3. Regression Analysis of Each System of Learning Power and Learning Effect of Engineering Students

3.1 Regression Analysis of Engineering Students' Learning Outcomes and Motivation Power System

This part of the study takes the four factors of the motivation power system of engineering students, namely learning motivation, learning interest, learning attitude and learning will, as independent variables and learning outcomes as dependent variables, and conducts multiple linear regression analysis of the factors of the dynamic system and learning outcomes. The analysis results are shown in Table 14 below. The R2 value of the model is 0.790, less than 1, indicating that the model has a good fit. Four factors can explain 79.0% of the variation in learning outcomes. Secondly, the F value in the analysis of variance is 482.590, p=0.000, less than 0.001, indicating that at least one of the four factors can significantly affect the learning outcomes of engineering students. The model constructed is meaningful, and the model is significant overall specific analysis shows that learning motivation can significantly positively affect learning outcomes (β=0.352, $p=0.000 < 0.01$), learning interest can significantly positively affect learning outcomes (β=0.679, $p=0.000 < 0.01$), and learning attitude can significantly positively affect learning outcomes (β=0.611, $P = 0.000 < 0.01$). $p=0.021 < 0.05$), the will to learn can significantly positively affect the learning outcomes (β=1.678, $p=0.000 < 0.01$). Finally, the standardized regression equation that can be obtained between the independent variable and the dependent variable is: learning outcomes =0.167* learning motivation +0.185* learning interest +0.153* learning attitude +0.435* learning will.

Table 14 Multiple Linear Regression Analysis of Learning Outcomes and Motivation Power System of Engineering Students(n=517)

Model	Unnormalized Coefficient	Standardization Coefficient		Significance	R2	Adjusted R2	F
	B	Standard Error	Beta				
(Constant)	2.888	1.039		0.006	0.790	0.789	F (4,516)= 482.590, p=0.000
Learning Motivation	0.352	0.097	0.167	0.000			
Learning Interest	0.679	0.129	0.185	0.000			
Learning Attitude	0.611	0.263	0.153	0.021			
Learning Will	1.678	0.230	0.435	0.000			

Dependent Variable: learning outcomes
Durbin-watson Value: 1.921

3.2 Regression Analysis of Engineering Students' Behavior Power System and Learning Outcomes

This part of the study takes the four factors of engineering students' behavior power system, namely knowledge acquisition, knowledge understanding, knowledge transformation and knowledge innovation, as independent variables, and learning outcomes as dependent variables, and conducts multiple linear regression analysis of behavioral force system factors and learning outcomes. The analysis results are shown in Table 15 below. The R2 value of the model is 0.781, which is less than 1, indicating that the model has a good fit, and the four factors can explain 78.1% of the changes in learning outcomes. Secondly, the F value in the analysis of variance is 455.838, p=0.000, less than 0.001, indicating that at least one of the four factors can significantly affect the learning outcomes of engineering students. The model constructed is meaningful and the model is significant as a whole. The concrete analysis of the data shows that knowledge acquisition can significantly positively affect learning outcomes (β=0.595，p=0.001＜0.01, Knowledge understanding had a significant positive impact on learning outcomes (β=0.347, p=0.048 < 0.05), knowledge transformation had a significant positive impact on learning outcomes (β=1.278, p=0.000 < 0.01), and knowledge innovation had a significant positive impact on learning outcomes (β=0.794, p=0.000 < 0.01). Finally, the standardized regression equation that can be obtained between the independent variable and the dependent variable is: learning outcomes =0.196* knowledge acquisition +0.118* knowledge understanding +0.329* knowledge transformation +0.270* knowledge innovation.

Table 15 Multiple Linear Regression Analysis of Learning Outcomes and Behavior Power System of Engineering Students

Model	Unnormalized Coefficient		Standardization Coefficient	T	Significance	R2	Adjusted R2	F
	B	Standard Error	Beta					
(constant)	3.830	0.999		3.836	0.000	0.781	0.779	(4,516)=455.838, p=0.000
Knowledge Acquisition	0.595	0.176	0.196	3.384	0.001			
Knowledge Understanding	0.347	0.175	0.118	1.979	0.048			
Knowledge Transformation	1.278	0.230	0.329	5.548	0.000			
Knowledge Innovation	0.794	0.200	0.270	3.975	0.000			

Dependent variable: learning outcomes
Durbin-watson values: 1.908

3.3 Regression Analysis of Engineering Students' Learning Adjustment Power System and Learning Outcomes

In this part of the study, the three factors of the adjustment power system of engineering students' learning power, including goal setting, self-monitoring and evaluation adjustment, were taken as independent variables, and the learning outcomes was taken as dependent variable, and the multiple linear regression analysis of the adjustment system factors and learning outcomes was conducted. The analysis results are shown in Table 16 below. The R2 value of the model is 0.766, which is less than 1, indicating that the model has a good fit, and the three factors can explain 76.6% of the change of learning outcomes. Secondly, the F value in the analysis of variance is 560.981, p=0.000, less than 0.001, indicating that at least one of the three factors can significantly affect the learning outcomes of engineering students. The model constructed is meaningful and the model is significant as a whole. The specific analysis of the data found that goal setting had a significant positive impact on learning outcomes (β=0.687, p=0.000 < 0.01), self-monitoring had a significant positive impact on learning outcomes (β=1.742, p=0.000 < 0.01), and assessment adjustment had a significant positive impact on learning outcomes (β=0.518, p=0.026 < 0.05). Finally, The standardized regression equation that can be obtained between the dependent variables and the independent variable is: learning outcomes =0.183* goal setting +0.590* self-monitoring +0.133* assessment adjustment.

Table 16 Multiple Linear Regression Analysis of Engineering Students' Learning Outcomes and Adjustment Power System (n=517)

Model	Unnormalized Coefficient		Standardization Coefficient	T	Significance	R2	Adjusted R2	F
	B	Standard Error	Beta					
(constant)	4.391	1.015		4.326	0.000	0.766	0.765	(3,516) =560.981, p=0.000
Goal setting	0.687	0.181	0.183	3.790	0.000			
self-monitoring	1.742	0.152	0.590	11.439	0.000			
Assessment Adjustment	0.518	0.232	0.133	2.232	0.026			

Dependent variable: learning outcomes
Durbin-watson values:1.900

3.4 Regression Analysis of Engineering Students' Learning Support Power System and Learning Outcomes

In this part of the study, three factors of engineering students' learning support power system, namely teacher support, classmate support and family support, were taken as independent variables, and learning outcomes was taken as dependent variable, and multiple linear regression analysis was conducted on the supporting system factors and learning outcomes. The analysis results are shown in Table 17 below. The R2 value of the model is 0.721, which is less than 1, indicating that the model has a good fit, and the three factors can explain 72.1% of the changes in learning outcomes. Secondly, the F value in the analysis of variance is 440.881, p=0.000, less than 0.001, indicating that at least one of the three factors can significantly affect the learning outcomes of engineering students. The model constructed is meaningful and the model is significant as a whole. Specific analysis of the data found that teacher support had a significant positive impact on learning outcomes (β=1.376, p=0.000 < 0.01), classmate support had a significant positive impact on learning outcomes (β=0.811, p=0.000 < 0.01), and family support had a significant positive impact on learning outcomes (β=0.401, P =0.000 < 0.01). p=0.011 < 0.05). Finally, the standardized regression equation that can be obtained between the independent variable and the dependent variable is: learning outcomes =0.480* teacher support +0.274* classmate support +0.132* family support.

Table 17 Multiple Linear Regression Analysis of Engineering Students' Learning Outcomes and Support Power System (n=517)

Model	Unnormalized Coefficient B	Unnormalized Coefficient Standard Error	Standardization Coefficient Beta	T	Significance	R2	Adjusted R2	F
(constant)	5.427	1.157		4.691	0.000	0.721	0.719	(3,516)=440.881, p=0.000
Teacher Support	1.376	0.143	0.480	9.598	0.000			
Classmate Support	0.811	0.162	0.274	5.018	0.000			
Family Support	0.401	0.158	0.132	2.547	0.011			

Dependent variable: learning outcomes
Durbin-watson values: 1.963

Discussion

1. This study found that there were no significant differences between male and female students in motivation power system, behavior power system , adjustment power system, support power system and learning outcomes, which was inconsistent with the results of Jie Tang, (2021: 27), although Stephanie Atkinson, (2008: 26) found that there were significant differences between boys and girls in academic performance. However, in this study, there are no significant differences between male and female students in learning power systems and learning outcomes, which may be due to the particularity of the research objects in this study. The number of female students majoring in engineering is relatively small, and the academic performance of female students majoring in engineering is better than that of female students in high school, thus narrowing the gap between male students and engineering students.

2. The difference analysis results of this study showed that there are positive correlations between the four systems of learning power and learning outcomes to varying degrees. The scores of senior students in learning power and learning outcomes are significantly higher than those of junior students, which is consistent with the research results of Yun Luo, (2012: 90). The learning power is positively correlated with the grade level. At the same time, practical activities in and out of school also enhance students’ ability and help students establish positive values, which have a profound impact on the development of students. All these contribute to the improvement of senior students’ learning power, making senior students’ learning power higher than that of juniors.

3. Those who participated in discipline competitions scored significantly higher on the four systems of learning power and learning outcomes than those who did not participate in discipline competitions, and those who participated in the teacher's project research or interest group scored significantly higher on the four systems of learning power and learning outcomes than those who did not participate in the teacher's project research or interest group. These results are basically consistent with the research results of Chengyu Jiang, (2015: 44), Jie Tang, (2021: 34), and Weiguang Zhou, (2018: 45), indicating that the overall learning ability and learning outcomes of CPC members (including probationary party members), those who have participated in discipline competitions, and those who have participated in teachers' research projects or interest groups are higher than those who have not had such experience. Subject competitions and interest groups promote students to combine theoretical knowledge with practice, exercise college students' learning thinking and learning ability, and transform what students learn at school. Therefore, universities and teachers should actively encourage students to participate in subject competitions or interest groups in various forms.

Suggestions

Under the background of the new era, the rapid innovation of engineering science and technology and the integration and cluster development of strategic emerging industries have put forward higher requirements and new challenges to the cultivation system of engineering talents in colleges and universities. To explore and innovate the cultivation system of "resilient talents" that adapts to the individual development of students and the needs of industry is an inevitable requirement to achieve the cultivation system goal of new engineering talents in the new era and improve the quality of talent cultivation. The research shows that the factors affecting the improvement of college students' learning power are multi-level and all-round. Therefore, in the process of improving college students' learning power, we should not only focus on the reality, but also look at the future, land in the overall situation, and systematically and comprehensively analyze the methods and measures to improve college students' learning power, which can be focused on the following aspects.

1. To Establish an Educational Concept of " Student Development-Orientated ".

Learning motivation, learning behavior, learning adjustment and support can significantly affect the learning outcomes. Based on these four main lines, it is necessary to systematically improve the level of college students' learning power. For example, starting from the learning motivation, and settling on the university's learning interest, learning will and learning attitude and other internal motivation, encourage the formation of college students' learning motivation system; Based on the behavioral power of learning, colleges and universities should play the main role, guide college students to formulate scientific and effective learning strategies and explore suitable and feasible learning methods, and constantly optimize the process of knowledge acquisition, understanding, transformation and innovation; Focus on the cultivation of college students' learning adjustment ability, guide students to clearly recognize their goals, always pay attention to their learning status and progress, understand their strengths and weaknesses, formulate reasonable learning plans and goals, and constantly reflect and adjust during learning; Pay attention to the factors of school support, classmate support and family support, and provide the external power support points for the improvement of college students' learning power, so as to improve the level of college students' learning power.

2. To Promote the Teaching Concept of "Teaching for the Unknown and Learning for the Future".

Teachers should shift from teaching knowledge to helping students learn how to learn, work, cooperate, and survive in order to adapt to the challenges of future uncertainty. The learning goal of students should be changed from coping with exams to making themselves develop comprehensively, harmoniously and fully in moral, intellectual, physical, beauty and labor through personalized independent learning. The goal of the course is to adhere to the organic integration of knowledge, ability and quality, and to cultivate students' comprehensive ability to solve complex problems and advanced thinking; The teaching content should reflect the cutting-edge and epochal, and timely introduce the cutting-edge achievements of academic research and scientific and technological development into the curriculum; Course content design should enhance research, innovation and comprehensiveness, increase students' learning input, scientifically "increase the burden", and let students experience the learning challenge of "jumping to get". It is necessary to resolutely eliminate the "water class", strive to create a "gold class", completely cancel the "clear examination", so that "the teaching materials are fine, the classroom is alive, the students are busy, the management is strict, and the effect is real." We should actively explore new forms of curriculum resource construction, adhere to the concept of "construction and use, continuous improvement, co-construction and sharing, intelligent teaching", and speed up the updating and iteration of teaching resources.

3. To Practice the Learning Concept of the "Practice-Driven"

Practice is the source and purpose of cognition, but also the driving force of cognition development. In "practice", students can improve their problem awareness, critical thinking, independent thinking ability, practical ability and communication and cooperation ability, and exercise the quality of perseverance. And finally made a breakthrough. Colleges and universities can rely on the advantages of disciplines and industries, take the research and development of real projects and real products in the industry and scientific research as the carrier, create a real learning environment and platform construction for engineering practice under the new engineering background, build an integrated engineering practice teaching system that integrates "knowledge, skills and consciousness", and realize the transformation and upgrading of students' practical ability cultivation mode from "fragmentation" to "systematization". And through teaching research, put forward the evaluation index system of engineering practice ability development, deepen the closed-loop mechanism of curriculum continuous improvement, and promote the spiral progressive improvement of students' engineering practice and innovation ability.

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