

The Relationship among Learning Psychological Process, Learning Behavior and Learning Outcome

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Abstract—We develop and test a theoretical model to investigate the relationship among learning psychology process, learning behavior and learning outcome. Structural Equation Model was used to estimate the relationship. Results by analyzing self-cognitive data of undergraduates' from one university in China show that the model is verified, where learning behavior mediates the impact of learning psychology process on learning outcome, and visible learning behavior has effect on invisible learning behavior.

Keywords—learning psychological process; learning behavior; learning outcome

I. INTRODUCTION

Learning outcome is an important indicator to predict higher education quality, which is affected by factors including students' engagement in learning. Student engagement attracted initially growing interest as a way to ameliorate low level of academic achievement, high level of student boredom and disaffection, and high dropout rates in urban areas.[1] And now has become one of the most important things assessing students learning status, such as National Survey of Students Engagement. And although there is evidence to suggest psychological engagement's importance to school performance[2][3], the majority of research has focused on the more observable indicators that are related to academic and behavioral engagement in learning, and less research has focused on psychological engagement.[4] It's well known that learning psychology has effects on learning outcome by learning behavior. But there is no evidence to demonstrate the relationship among them. Drawing on related literature, we develop a theoretical model to explain how learning psychology process and learning behavior influence learning outcome. Then describe construct operationalization and data collection method, present the empirical analysis procedure using SEM and discuss the findings. This paper concludes with a discussion about our findings.

II. THEORETICAL FRAMEWORK AND RESEARCH MODEL

The foundation of our theoretical comprises of two elements: learning psychology process and learning behavior (see FIGURE 1). Psychology process is one of the basic psychology phenomena.

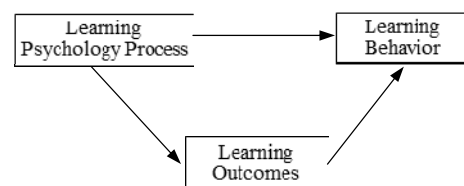


FIGURE 1. THEORETICAL FRAMEWORK

As a learner, student who has a positive psychology process may have a good learning outcome. On one hand positive psychology process has direct effect on learning outcome by influencing brain processes. And on the other hand it has indirect effect by influencing learning behavior.

A. Learning Psychology Process and Learning Outcome

A learning psychology process is a process that cognition, affection, emotion, and willpower interact with one another, which related directly with learning outcome. [5,6] First, the cognition to learning refers to judging the learning value or significance. Any learning content has its own significance, which does not exists clearly in learning content. When the learners explain actively the experiences that learning content shows by using their cognitions, they have grasped naturally the significance of learning content. The process is at essence a process that the learners gain some outcomes. Second, the affection to learning refers to an attitude to learning, which shows to some extend student's striving in or weary of his studies. As a psychologist said, affection interlaces with thinking, and has positive or passive influence. And many tests show that once a student lose positive affection to learning, his cognitive function, such as thinking or memory, would be constrained. That is, affection can exert much influence on learning outcome directly. Third, learning emotion refers to attitude at level of biological needs, showing physiological experiences for possibility of learning success, such as happy or disappointed. Compared with affection, emotion is characterized by situation and perishability. And it has effect on cognition by mood, which influences brains' collecting memory, reasoning content, processing method and making decision. And positive mood does accelerate the brain function and then affect learning outcome energetically. Last, learning willpower refers to ability that student can overcome difficulties in learning. And a student, who has stronger

willpower, can control his cognitive actions by adjusting his affection and emotion. So willpower affects learning outcome. So we propose that

Hypothesis 1: more positive learning psychology process leads to better learning outcomes.

B. Intermediation of Learning Behavior

1) Learning Psychology Process and Learning Behavior:

During learning, students can grasp significance of learning content by constructing relationship between old and new knowledge, which may urge students to pay more attention to and engage more in learning. And in fact, students always accept one learning task under some condition of affection and emotion. First, affection can initiate, inspire, maintain and regulate learning behavior, so active affection can improve learning behavior. Second, when students feel happy during learning, their good psychology can impel choosing similar behavior again. Positive emotion can drive students to finish a learning program and negative emotion does suppress learning enthusiasm. A group of international scholars focus on the linkage between students' emotions and their academic engagement and demonstrate the critical role of emotions in academic behaviors [7]. In addition, willpower can orient students' learning behavior to some goals. Learning is a process full of challenges and gumptions, it's normal that a student meets some difficulties. At that time, he needs willpower to control himself to insist learning behavior. So learning psychological process affect directly students' choice of learning behavior: positive one can initiate positive learning behavior, and in turn negative one leads to negative learning behavior. So we propose that

Hypothesis 2: more positive learning psychology process leads to more positive learning behavior. And according to classification of learning behavior in next paragraph, we subdivide H2 into H2a: more positive learning psychology process leads to more positive visible learning behavior, and H2b: more positive learning psychology process leads to more positive invisible learning behavior.

2) Learning Behavior and Learning Outcomes:

In school settings, learning behavior is important because it predicts learning outcomes, such as achievement, development, and so on [8]. That is, positive involvement in learning predicts better outcomes.

According to behavioral and cognitive learning theories, learning behavior can be divided into two kinds: visible and invisible. Behavioral learning theory suggests that learning behavior means students' feedback to learning tasks. Behavioral engagement functions as a pathway by which students' some psychology processes contribute to their subsequent learning [9]. And positive learning behavior, such as active, collaborative, and cooperative learning, does promote or reinforce learning outcomes.[10] Cognitive learning theory stresses cognitive process of learning which includes information acceptance, processing, storage and extraction and hides in brain. Deep learning is regarded as an effective approach of invisible learning behavior, which represents students looking beyond the signs associated with information to the more important underlying meaning. So deep learning is

connected positively to academic outcomes [11]. So we propose that

Hypothesis 3: learning behavior has intermediation between learning psychology process and learning outcomes, which is subdivided into H3a: visible learning behavior has intermediation between learning psychology process and learning outcomes, and H3b: invisible learning behavior has intermediation between learning psychology process and learning outcomes.

3) Visible and Invisible Learning Behavior:

In addition, construction learning theory suggests that learning is a process finishing knowledge construction during students' interaction with environment, which means that interactivity is a vital factor. Researches on effective educational practices [12] and higher education instruction [13] demonstrate that positive learning behavior has more influence on deep learning. And students can enforce deep learning through interactivity, such as collaboration with classmates, or interaction with faculty. [14] So we propose that

Hypothesis 4: more positive visible learning behavior leads to more positive invisible learning behavior.

Based on discussion above, we construct the research model (see FIGURE II)

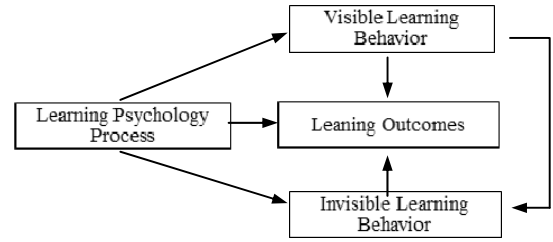


FIGURE 2. RESEARCH MODEL

III. RESEARCH DESIGN

A. Construct Operationalization

We used the survey method to test our model, and used NSSE-China as the survey instrument.

Learning psychology process (LPP) was measured in terms of the extent of overcoming difficulties, liking learning, feeling happy during learning, and perceived significance of learning content.

Visible learning behavior (VLB) was measured in terms of the frequency of active, collaborative, and cooperative learning behavior, including eight items of worked with classmates outside of class to prepare class assignments, worked with other students on task during class, discussed ideas with others outside of class, thought or responded to questions without fixed answer in classroom, tutored or taught other students, made a class presentation, asked question in class or contributed to class discussion, and discussed ideas with faculty outside of class.

Invisible learning behavior (ILB) was measured in terms of the frequency of cognition activities, including six items of

tried to better understand someone else's views by imaging how an issue looks from his perspective, learned something that changed the way you understand an issue, introspecting one's own learning process, put together ideas or concepts from different courses when completing assignments or discussions, synthesizing ideas or information into new interpretations and relationships, examined the strengths and weaknesses of you own view in a topic.

Learning outcomes (LO) was measured in terms of the extent of value addition, including four items of acquiring a broad general education, acquiring job or work-related knowledge and skills, thinking critically, and solving real-world problems.

B. Data Collection

The survey was administered to undergraduates. A sample was randomly drawn from students at every grade of one university in China. And 996 questionnaires were completed and usable for data analysis.

IV. DATA ANALYSIS AND RESULTS

Analyses of the data were completed using SPSS19 and LISREL 8.7, and performed at the 0.05 level of significance.

A. Data Preparation

To understand if underlying dimensions of every concept were logical, reliability test and construct validity test were performed on the data. On the hand of reliability, we used Cronbach's alpha (α) to confirm if internal reliability is reasonable. LPP scale α can be adjusted to 0.637 from 0.573 after deleted LPP4. And α of VLB, ILB and LO scales were respectively 0.745, 0.778 and 0.698, all over the recommended value of 0.6 and showed that the data were reliable. On the hand of construct validity, we used factor analysis to demonstrate that some items can be reduced to a simple size. Kaiser-Meyer-Okin (KMO) values of LPP, VLB, ILB and LO were in turn 0.658, 0.778, 0.768, 0.735, all over the recommended value of 0.6 and the four factor construct also had a significant result (sig.=000) on Bartlett's test of sphericity, which showed that there did exit communality among items of every scale.

Discussion above shows that LPP scale is acceptable after adjusted, and other scales are reasonable.

Kolmogorov-Smirnov and Shapiro-Wilk tests show that each item of the major constructs is approximately and normally distributed. Q-Q plot also indicate that our data are approximately and normally distributed. So we can use structural equation model (SEM) method to analyze the data.

B. Structural Equation Model

We set research model as the model 1(see FIGURE I), in which there are 4 latent variables and LPP has direct and indirect effects on LO.

To test the mediation of learning behavior, we chose model 2 to be compared with model1. Thereinto, LPP has indirect effect on LO only through learning behavior (see FIGURE III).

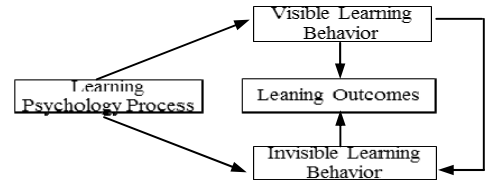


FIGURE 3. MODEL 2

Results from SEM analyses suggest that the fitness of model 1 is better than model 2(see TABLE I). χ^2/df is 3.73, over 3 and below 5, showing the fitness is acceptable. RMSEA is 0.05(<0.1). NNFI、NFI 和 CFI are respectively 0.958、0.951and 0.963, all over 0.9. The fitness of model 2 and model 3 are all acceptable, but worse than that of model 1. So we

TABLE I. FITNESS COMPARISON

Model	χ^2	df	χ^2/df	RMSEA	NNFI	CFI
1	683.38	183	3.73	.050	.958	.963
2	698.56	184	3.80	.556	.957	.962

confirm model 1 is the fittest model. And the path diagram is as FIGURE IV.

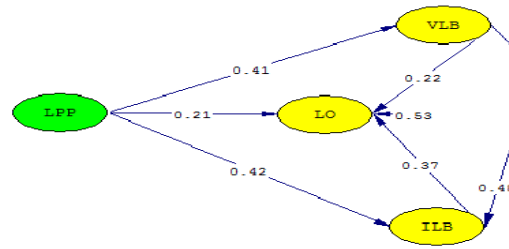


FIGURE 4. PATH DIAGRAM

C. Hypothesis Testing

Figure 4 presents the main estimates obtained from SEM analysis. The R^2 value of 0.53 indicates that the model explain almost half amount of variance for learning outcomes. As shown in FIGURE IV and TABLE II, LPP relates significantly

TABLE II. HYPOTHESES TEST

H	Path	Standard estimates	T Value	Significance
H1	LPP—LO	0.21	1.936	P>0.05
H2a	LPP—VLB	0.41	4.386	P<0.001
H2b	LPP—ILB	0.42	4.452	P<0.001
H3a	VLB—LO	0.22	2.015	P<0.050
H3b	ILB—LO	0.37	2.545	P<0.050
H4	VLB—ILB	0.48	4.756	P<0.001

to LO (.21, P>0.05) , VLB (.41, P<0.001) and ILB (.42, P<0.1) , VLB relates significantly to LO (.22,P<0.05), ILB relates significantly to LO (.37,P<0.05) and VLB relates significantly to ILB (.48,P<0.001).

The results provide evidence for hypotheses. First, the LPP-LO link is not significant, hence H1 is not supported. Second, the hypothesized mediating role of LB (including VLB and ILB) between LPP and LO is tested: the LPP-VLB link and the VLB-LO link are significant, the link LPP-ILB and the link ILB and LO are significant, offering evidence for H2 and H3. Third, we further demonstrate that the effect of VLB on ILB is significant, so H4 is supported.

As shown in FIGURE IV, LB has significant influence on LO. LB's effect on LO can be expressed in two parts: One part is that VLB has influence on LO and the whole effect is 0.4, in which the direct effect is 0.22 and the indirect effect by ILB is 0.18. The other part is that ILB has direct influence on LO and the effect is 0.37. LPP related to LO through indirect path, the whole indirect effect is 0.32, and there exist three indirect paths: first, LPP has influence on LO through VLB and the effect is 0.09; second, LPP has influence on LO through ILB and the effect is 0.16; third, LPP has influence on LO through VLB and ILB in turn, and the effect is 0.07. Those results indicate that LPP has indirect influence on LO, and LB (including VLB and ILB) mediates the impact of LPP on LO. The effects can be summarized as shown in TABLE III.

TABLE III. THE EFFECTS

Variables		Path	Effects	Whole Effects
LB	VLB	direct	0.22	0.4
		indirect	0.18	
	ILB	direct	0.37	0.37
LPP	indirect	VLB	0.09	0.32
		ILB	0.16	
		VLB-ILB	0.07	

V. DISCUSSION

We focused on two important facets of learning outcomes: first, learning psychology process showed to much extent learning tendentiousness. Many research demonstrated that learning psychological feature related to academic achievement. Second, learning behavior that happened actually is the base of learning outcomes. Undergraduates' learning is characterized by autonomy, so students' experiences are important. So we focused on learning psychology process and learning behavior.

By elaborating our conceptual model in terms of the one learning psychology process and two learning behavior, we offer a rich set of results. Broadly, we find learning psychology process affect learning outcomes in different and indirect ways, and mediated by learning behavior. First, we find that learning psychology process do not significantly and directly affects learning outcomes, and its effect on learning outcome is mediated by visible learning behavior and invisible learning behavior. These support our research framework of the interaction between learning psychology process and learning behaviors. There are two plausible explanations to this finding. First, leaning psychology process can affect indirectly learning outcomes. So it's important for students to have positive learning psychology process. Second, if there were no active learning behaviors, learning psychology process would have on significant influence on learning outcomes. So in educational practice, educators should pay attention to not only students'

learning enthusiasm but also providing chances for learning behavior and making them engaging in learning.

VI. CONCLUSION

Drawing broadly on learning psychology, learning behavior and learning outcomes, we developed and tested a research model. Results from SEM analysis shows that the hypotheses are all demonstrated: learning psychology process affects learning outcomes by indirect way, learning behavior mediates the influence of learning psychology process on learning outcomes, and visible learning behavior affects invisible learning behavior. The results indicate that in education practice, we should focus on both learning psychology process and learning behavior to improve learning outcomes better.

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