An Analysis on the Influencing Factors of Learning Motivation Based in the Teaching Blending Online and Offline: The Mediating Role of Self-efficacy and Task value

Lin Wei¹, Xiaoxue Chen², Mingyue Zheng³, Li He¹, Xiaotong Zhang¹, and Yuan Gao¹,∗

¹School of Intelligent Medical, Chengdu University of Traditional Chinese Medicine, People’s Republic of China
²Research Center for Psychological and Health Sciences, China University of Geosciences (Wuhan), People’s Republic of China
³Adelaide Medical School, University of Adelaide, Australia

Abstract. Discuss the influence of the teaching blending online and offline on the learning motivation of linear algebra and other mathematical courses. University students of grade 2021 were chosen as the research object by using the stratified sampling and random sampling methods. The Adapted Motivation Strategy of Learning Questionnaire was used. The structural equation model and the mediation effect model were applying to analyze the influencing effect of learning motivation. External Drive positive effects Learning beliefs by influencing the mediating role of Self Efficacy. Internal Drive positive effects Learning beliefs by influencing the mediating role of Task Value. The organic combination of traditional classroom blackboard deduction and online teaching, the improvement of internal motivation and external motivation and the improvement of self-efficacy and task value are conducive to the optimization of the teaching blending online and offline of mathematics and physics courses.

Keywords: Learning motivation, Mediating effect, Structural equation model.

1 Introduction

With the development of the mode of Internet plus education, Massive Open Online Course and other forms of modern teaching means are widely used in teaching, and play an important role in promoting the reform and innovation of teaching, developing high-quality education, and strengthening the sharing of educational resources [1]. Traditional teaching is based on the classroom teaching model of “textbook + chalk + blackboard”, which students as a passive participants can’t be well integrated into the teaching process. Courses with high requirements for mathematics and physics fundamentals are abstract and logical, which is difficult for students to master. Therefore, the single online teaching effect is often unsatisfactory due to the lack of the atmosphere of offline courses, interaction and effective guidance from teachers [2]. Thus, it is a better choice to combine traditional classroom blackboard deduction with online teaching. The new challenge of blending teaching is how to design a teaching mode organically combining online and offline courses and how to transform [3], adjust and optimize the corresponding teaching concepts, teaching methods and teaching means to achieve the best teaching effect.

*e-mail: 646058694@qq.com

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As a basic course, linear algebra plays a very important role in all courses during the university time. In contrast to the elementary mathematics, linear algebra’s is based on a close combination of algebra and geometry. The characteristics of linear algebra are very significant: high abstraction, rigorous logic, and wide application. To discuss the factors of the learning motivation of linear algebra in the teaching mode blending online and offline [4], this study makes the following investigation: University students who need to learn linear algebra in grade 2021 were chosen by using stratified sampling and random sampling methods. The adapted Motivation Strategy of Learning Questionnaire (MSLQ) [5, 6] was used. The structural equation model and mediation effect model were applied to analyze the influencing factors of learning motivation, in order to improve students’ learning motivation and provide reference for the later teaching of linear algebra and other mathematical and mathematical courses. Section 1 introduces the background of the development of teaching blending online and offline. Section 2 presents relevant literature studies. The survey object and data analysis method is showed in the Section 3, and the following Section is the result analysis of the structural equation model and the medium effect model. Section 5 is the result interpretation of the data. Section 6 is the conclusion of this paper.

2 Theoretical Analysis and Hypothesis

2.1 The Total Effect of External Drive on Learning Beliefs

Learning is closely related to learning interests, learning demands and personal values. Learning motivation plays a dominant role in it. How to improve learning motivation of linear algebra under the teaching mode blending online and offline is crucial for mastering the key points of linear algebra. Harris J [7] measured the self-efficacy of learning three times to find the different effects of teaching methods on the growth of students. Malespina A [8] considered the role of self-efficacy in college physics learning and explained the importance of self-efficacy in learning. Thus, the hypothesis is proposed as followed:

\textit{Hypothesis 1}. External Drive positive effects Learning beliefs by influencing the mediating role of Self Efficacy.

2.2 The Total Effect of Internal Drive on Learning Beliefs

Learning motivation is a kind of motivation tendency that guides and maintains students’ learning behavior and directs it to the academic goal. Bailey D R [9] believed that self-efficacy and task value were two motivational factors affecting learning participation and language learning, found that self-efficacy completely mediated the relationship between task value and learning participation, proposed that the improvement of task value explained the value of SNLL to language learning. Tonks S M [10] found that competency belief are positively correlated with reading comprehension and task value when discussing the relationship between situational reading-related ability beliefs and task value, reasoning strategies, reading comprehension and basic skills. Schommer [11] proposed that belief system is composed of knowledge structure, stability of knowledge, speed and control of knowledge acquisition. Thus, the hypothesis is proposed as followed:

\textit{Hypothesis 2}. Internal Drive positive effects Learning beliefs by influencing the mediating role of Task Value.
3 Research Object and Data Selection

3.1 Research Object

University students who need to learn linear algebra in grade 2021 selected as the research objects were investigated by cross-sectional method, combined with stratified sampling and random sampling method. In this survey, 300 questionnaires were distributed and 273 valid questionnaires were collected, with an effective rate of 91%. Among them, 169 were female and 104 were male students, ranging in age from 17 to 21, who all were medical students and related majors.

3.2 Design of Questionnaire

Questionnaire used in this study adapted from the Motivation Strategy of Learning Questionnaire (MSLQ) [5] which was compiled by Anthony and Altino is a self-reporting scale which mainly measures students’ self-learning ability and contains 31 items, including six dimensions: external drive, internal drive, task value, learning beliefs, self-efficacy and examination anxiety. Each item is scored on a 5-point Likert scale (1. Very inconsistent; 2. Relatively inconsistent; 3. Don’t know. 4. Relatively match 5. Fit perfectly). The total score is 217. The higher scores it is, the greater learning motivation it indicates. In this study, Cronbach’s $\alpha$ was 0.842 [12], indicating good reliability.

3.3 Statistic Method

EpiData was used to establish a database, SPSS26.0 and AMOS23.0 were applied for statistical analysis. The structural equation model was built to describe the factors that influence learning motivation under the teaching mode blending online and offline. The deviation-modified non-parametric percent-position interval Bootstrap method was used to test the mediating role of self-efficacy and task value by sampling 1000 times repeatedly.

4 Empirical Analysis

4.1 Principles of Structural Equation Modeling

Structural equation model [13] is a multivariate statistical method that uses linear equations to express the causal relationship between variables based on the covariance matrix of variables. It includes two parts: the measurement model and the structural model. The matrix equation is:

$$
\begin{cases}
X = \Lambda_x \xi + \delta \\
Y = \Lambda_y \eta + \varepsilon.
\end{cases}
$$

(1)

$$
\eta = \beta \eta + \Gamma \xi + \zeta.
$$

(2)

The formula 1 is the measurement equation, The formula 2 is the structural equation, where $X$ is a vector composed of exogenous indicators, and $Y$ is a vector composed of endogenous indicators, $\xi$ is a vector of exogenous latent variables, $\eta$ is a vector of endogenous latent variables, $\Lambda_x$ is a coefficient matrix that reflects the strength of the relationship between exogenous observation variables and exogenous latent variables; $\Lambda_y$ is a coefficient...
matrix reflecting the strength of the relationship between endogenous observed variables and endogenous latent variables, $\delta$ represents the measurement error of exogenous variables, $\varepsilon$ represents the measurement error of the endogenous variable, $\beta$ represents the coefficient matrix of the endogenous latent variable, $\Gamma$ represents the coefficient matrix of the exogenous latent variable, $\zeta$ represents the error of the structural equation.

4.2 Analysis of Influencing Factors

This study intends to construct a structural equation index system composed of six basic dimension latent variables [14], which are external drive, internal drive, task value, learning beliefs, self-efficacy, and examination anxiety (figure 1). The theory assumes that there is a direct relationship between external drive, internal drive, task value, learning beliefs, self-efficacy, and examination anxiety. The structural relationship model was shown in figure 1.

Learned from Table 1, the standard path coefficient of the effect of learning beliefs on self-efficacy was 0.236 and showed significant in the 0.001 level ($z = 5.725, p = 0.000 < 0.001$). Thus, learning beliefs positively affected self-efficacy.

The standard path coefficient of the effect of task value on self-efficacy was 0.654 and showed significant in the 0.001 level ($z = 15.860, p = 0.000 < 0.001$). Thus, task value positively affected self-efficacy.

The standard path coefficient of the effect of examination anxiety on learning beliefs showed insignificant in the 0.05 level ($z = -0.200, p = 0.842 > 0.05$), which indicated that examination anxiety did not affect learning beliefs significantly.

![Figure 1. Structural equation mode](image)
Table 1. Model regression coefficient

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>Path coefficient</th>
<th>SE</th>
<th>z/CR</th>
<th>p</th>
<th>Standard path coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning beliefs</td>
<td>Self-Efficacy</td>
<td>0.576</td>
<td>0.101</td>
<td>5.725</td>
<td>&lt;0.001</td>
<td>0.236</td>
</tr>
<tr>
<td>Task Value</td>
<td>Self-Efficacy</td>
<td>0.854</td>
<td>0.054</td>
<td>15.86</td>
<td>&lt;0.001</td>
<td>0.654</td>
</tr>
<tr>
<td>Examination Anxiety</td>
<td>Learning beliefs</td>
<td>-0.005</td>
<td>0.025</td>
<td>-0.2</td>
<td>0.842</td>
<td>-0.01</td>
</tr>
<tr>
<td>Internal Drive</td>
<td>Learning beliefs</td>
<td>0.393</td>
<td>0.043</td>
<td>9.158</td>
<td>&lt;0.001</td>
<td>0.431</td>
</tr>
<tr>
<td>External Drive</td>
<td>Learning beliefs</td>
<td>0.374</td>
<td>0.036</td>
<td>10.415</td>
<td>&lt;0.001</td>
<td>0.483</td>
</tr>
<tr>
<td>Examination Anxiety</td>
<td>Internal Drive</td>
<td>0.051</td>
<td>0.026</td>
<td>1.977</td>
<td>0.048</td>
<td>0.09</td>
</tr>
<tr>
<td>Task Value</td>
<td>Internal Drive</td>
<td>0.386</td>
<td>0.027</td>
<td>14.434</td>
<td>&lt;0.001</td>
<td>0.657</td>
</tr>
<tr>
<td>Examination Anxiety</td>
<td>External Drive</td>
<td>0.131</td>
<td>0.039</td>
<td>3.326</td>
<td>0.001</td>
<td>0.197</td>
</tr>
</tbody>
</table>

"→" Indicates the path influence relationship

The standard path coefficient of the effect of internal drive on learning beliefs was 0.431 and showed significant in the 0.001 level (z = 9.158, p = 0.000 < 0.001). Thus, internal drive positively affected learning beliefs.

The standard path coefficient of the effect of external drive on learning beliefs was 0.483 and showed significant in the 0.001 level (z = 10.415, p = 0.000 < 0.001). Thus, external drive positively affected learning beliefs.

The standard path coefficient of the effect of examination anxiety on internal drive was 0.090 and showed significant in the 0.05 level (z = 1.977, p = 0.048 < 0.05). Thus, examination anxiety positively affected internal drive.

The standard path coefficient of the effect of task value on internal drive was 0.657 and showed significant in the 0.001 level (z = 14.434, p = 0.000 < 0.01). Thus, task value positively affected internal drive.

The standard path coefficient of the effect of examination anxiety on external drive was 0.197 and showed significant in the 0.001 level (z = 1.977, p = 0.001). Thus, examination anxiety positively affected external drive.

4.3 Mediating Effect

The path 1 represented “External Drive=>Self-Efficacy=>Learning beliefs”. The path 2 represented “External Drive=>Task Value=>Learning beliefs”. The path 3 represented “Internal Drive=>Self-Efficacy=>Learning beliefs”. The path 4 represented “Internal Drive=>Task Value=>Learning beliefs”. The path 1 and path 3 were not significant [15].

In path 2, the mediating effect of self-efficacy on the effect of external drive on learning beliefs was 0.182, which was statistically significant. It means that external drive has a positive impact on learning beliefs through affecting self-efficacy. For every percentage point increase in external drive, learning beliefs increases by 0.182 percentage points through the mediation approach of self-efficacy. Hypothesis 1 has been verified.

In path 4, the mediating effect of task value on the effect of internal drive on learning beliefs was 0.06, which was statistically significant. It means that internal drive has a positive impact on learning beliefs through affecting task value. For every percentage point increase in internal drive, learning beliefs increases by 0.06 percentage points through the mediation approach of task value. Hypothesis 2 has been verified.

Based on the test method of mediating effect proposed by Hayes, the bootstrap method was used to conduct 1000 repeated sampling to calculate 95% CI respectively [16], and the 95% CI of effect of the four paths was obtained, as shown in Table 3.

Since the lagged variables of the explained variable contains a lot of information about the dependent variable, adopting dynamic panel can effectively alleviate the endogeneity problem caused by missing variables[17]. Therefore, this study adds learning beliefs, self-efficacy and task value as explanatory variables to the original model to constitute a dynamic panel,
Table 2. Mediating effect result

<table>
<thead>
<tr>
<th>Items</th>
<th>Conclusion</th>
<th>C total effect</th>
<th>a*b mediating effect</th>
<th>c direct effect</th>
<th>Effect proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Drive =&gt; Self Efficacy =&gt; Learning beliefs</td>
<td>insignificant</td>
<td>0.374</td>
<td>0.047</td>
<td>0.145</td>
<td>0%</td>
</tr>
<tr>
<td>External Drive =&gt; Task Value =&gt; Learning beliefs</td>
<td>Complete meditation</td>
<td>0.374</td>
<td>0.182</td>
<td>0.145</td>
<td>100%</td>
</tr>
<tr>
<td>Internal Drive =&gt; Self Efficacy =&gt; Learning beliefs</td>
<td>Insignificant</td>
<td>0.393</td>
<td>0.035</td>
<td>0.298</td>
<td>0%</td>
</tr>
<tr>
<td>Internal Drive =&gt; Task Value =&gt; Learning beliefs</td>
<td>Partial meditation</td>
<td>0.393</td>
<td>0.06</td>
<td>0.298</td>
<td>15.24%</td>
</tr>
</tbody>
</table>

Table 3. 95%CI of respective effect

<table>
<thead>
<tr>
<th>Items</th>
<th>C total effect</th>
<th>a</th>
<th>b</th>
<th>a*b mediating effect</th>
<th>C direct effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Drive =&gt; Self Efficacy =&gt; Learning beliefs</td>
<td>0.283 –0.464</td>
<td>1.079 –1.378</td>
<td>-0.033 –0.110</td>
<td>-0.073 –0.191</td>
<td>-0.012 –0.301</td>
</tr>
<tr>
<td>External Drive =&gt; Task Value =&gt; Learning beliefs</td>
<td>0.283 –0.464</td>
<td>0.940 –1.152</td>
<td>0.074 –0.275</td>
<td>0.051 –0.370</td>
<td>-0.012 –0.301</td>
</tr>
<tr>
<td>Internal Drive =&gt; Self Efficacy =&gt; Learning beliefs</td>
<td>0.285 –0.501</td>
<td>0.749 –1.106</td>
<td>-0.033 –0.110</td>
<td>-0.047 –0.119</td>
<td>0.170 –0.425</td>
</tr>
<tr>
<td>Internal Drive =&gt; Task Value =&gt; Learning beliefs</td>
<td>0.285 –0.501</td>
<td>0.217 –0.470</td>
<td>0.074 –0.275</td>
<td>0.014 –0.108</td>
<td>0.170 –0.425</td>
</tr>
</tbody>
</table>

"a*b" means 95% bootstrap CI.

Table 4. Robustness test using generalized moment estimation method

<table>
<thead>
<tr>
<th></th>
<th>Learning beliefs</th>
<th>Self-Efficacy</th>
<th>Task Value</th>
<th>Learning beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td>β</td>
<td>6.139** (6.982)</td>
<td>1.312 (-0.904)</td>
<td>1.299 (1.263)</td>
<td>5.963** (6.891)</td>
</tr>
<tr>
<td>Examination Anxiety</td>
<td>-0.005 (-0.202)</td>
<td>-0.170** (-4.212)</td>
<td>0.058* (2.023)</td>
<td>-0.009 (-0.341)</td>
</tr>
<tr>
<td>External Drive</td>
<td>0.374** (8.098)</td>
<td>1.228** (16.118)</td>
<td>1.046** (19.361)</td>
<td>0.145 (1.812)</td>
</tr>
<tr>
<td>Internal Drive</td>
<td>0.393** (7.119)</td>
<td>0.928** (10.184)</td>
<td>0.344** (5.321)</td>
<td>0.298** (4.573)</td>
</tr>
<tr>
<td>Self Efficacy</td>
<td>0.038 (1.049)</td>
<td>0.174** (3.393)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Value</td>
<td>0.038 (1.049)</td>
<td>0.174** (3.393)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample size</td>
<td>273</td>
<td>273</td>
<td>273</td>
<td>273</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.547</td>
<td>0.777</td>
<td>0.78</td>
<td>0.569</td>
</tr>
<tr>
<td>$R_{adj}^2$</td>
<td>0.542</td>
<td>0.774</td>
<td>0.776</td>
<td>0.561</td>
</tr>
<tr>
<td>F</td>
<td>F (3,269)=108.288,</td>
<td>F (3,269)=311.961,</td>
<td>F (3,269)=315.000,</td>
<td>F (5,267)=70.490,</td>
</tr>
<tr>
<td></td>
<td>p=0.000</td>
<td>p=0.000</td>
<td>p=0.000</td>
<td>p=0.000</td>
</tr>
</tbody>
</table>

"*" means "p<0.05", "**" means "p<0.001", In the parentheses were t values.

and considers the lagged items of learning beliefs as its own IV tool variables. The above model is retested by regression to test the robustness of the results. The test results show that the P values of AR(2) and F test of all models are less than 0.001, indicating that second-order autocorrelation does not exist in all models and the instrumental variables are valid. Learned from Table 4, although the coefficient and significance level of the two intermediary paths have changed, the coefficient symbol and internal mechanism of the two paths have not altered, which further confirmed the robustness of the research results.
5 Results

Internal drive and external drive affect students’ achievement interactively. It is found that the money-driven group had a better visual perception learning effect than the non-money-driven group. For students, the quality of academic performance affects the application of scholarship. Students who are influenced by scholarship application have better visual perceptual learning effect in class. Therefore, they can get better results of linear algebra and other mathematics and physics general courses. Internal drive, derives from one’s own, is the self-generated motivation and a factor that affects the achievement. As an external environmental factor affecting students’ development, Teachers’ independent support can improve students’ internal motivation and thus have a significant impact on students’ academic performance and personality development.

Self-efficacy played a mediating role on the effect of external drive on learning beliefs. Task value played a mediating role on the effect of internal drive on learning beliefs. Learning beliefs is a higher level cognition of learning. Learning beliefs is a part of psychological capital, which affect the input and output of learning with other psychological factors. Therefore, students can change their understanding of learning beliefs, so as to change their learning state and effectively improve their academic performance. In the academic aspect, self-efficacy mainly refers to students’ confidence that they can effectively use their abilities to complete learning tasks. In mathematical courses such as linear algebra, students with high self-efficacy who are more proactive scored higher in the corresponding courses.

6 Conclusions

In this study, stratified sampling and random sampling methods, and the adapted Motivation Strategy of Learning Questionnaire (MSLQ) was used to collect data. Structural equation model and mediation effect model were applied to analyze the influencing factors of learning motivation. It was found that external drive positive effects learning beliefs by influencing the mediating role of self-efficacy and internal drive positive effects learning beliefs by influencing the mediating role of task value. Transform and optimize teaching concepts, teaching methods and teaching means, improve students’ sense of self-efficacy and task value to achieve the optimal teaching effect, and design the teaching mode that organically combines traditional physical classroom and online classroom, which will be the challenges that mathematical teaching is about to encounter.

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References