



Research on multi-mediating effects in educational assessment system

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Abstract: Learning behavior impacts greatly on study achievement. However, when we assess the process of students' study achievement, several mediating factors of indirect influences on study achievement cannot be ignored. This paper discusses mediating variables and related concepts. Four mediating variables are introduced to study the influence of learning behavior on achievement. A multiple linear regression model for mediating effects based on metrology is proposed to analyze the impact of each mediating factor on term study achievement.

Keywords: Educational assessment; Mediating factors; Multi-Mediator linear regression analysis.

1. Introduction

Teachers' emotional support is very important for high quality teaching^[1]. In this study, we explore whether the relationship between emotional support and learning outcomes can be explained by metrological theory. Based on this study, we examined the students' classroom performance and the role of various intermediaries in it. Analyses of the mediating effects of Initiative, teacher emotional support, relatedness with team members and competence on students' study achievement indicated significant mediating effects of teacher emotional support and relatedness with team members, in this sample of 460 students (ages 18–21) in 10 classes in Zhongshan Polytechnic College in Guangdong.

2. Mediating variables

In this research, we assume that we are interested in the relationship between the effect of the mediation variable (M) on the result (Y). Since mediating effect is indirect effect, structural equation model can be used to analyze mediating effect regardless of whether the variable involves latent variables, and assuming that all variables have been centralized, the following equation can be used to describe the relationship

between variables:

$$Y = bM + e \quad (1)$$

Here, M represents the mediating factor. Y represents the influence from factor M; E denotes the estimated value of dependent variable when all independent variables are zero, b is the partial regression coefficient, and represents the change of Y for each unit of independent variable M when the values of other independent variables are fixed.

460 participants (ages 18–21) were drawn from 12 classes in Zhongshan Polytechnic College in Guangdong. The ratio of male to female teachers is 0.7:1. Research program was run from term (2018-2019-1) to term (2018-2019-2).

Mediating factors involved are study initiative(M1), relatedness with team members(M2) teacher emotional support(M3) and competence(M4), respectively.

In total 460 students consented to participate in full-time college study (30% in freshman year, 30% in sophomore, 30% in Junior year). On average, 38 students consented per classroom.

Since the study is on explicit variables, the mediating effect can be estimated and tested only by the usual regression analysis.

2.1 Mediating Effect of Peer Relations

Students answered four questions in each end of semester assessing whether their team peers interacted with them in a supportive, positive, and respectful manner in the learning task. Items included "How does your peer cooperate with you on the task.", "How many students a team", "how hard is your last task on the class", and "How do you get along with". Student responses were arranged on a 5-point scale, and while the exact wording of the responses varied according to the item, the responses ranged from 1 to 5.

2.2 Mediating Effect of Teachers' Emotional Support

Teachers participated in this program were observed in terms of emotionally-supportive degree in the beginning of each term, students' behavioral engagement and motivation is recorded in each classroom.

Suppose we think that students 'behavior will affect teachers' emotional learning support, and the degree of teachers 'support will affect students' final learning results, then the degree of emotional support is a mediating variable. Emotional support domain is defined as teacher-student interactions that promote social connection, convey concern for students' feelings and interest in their individuality, and honor students' desire to learn meaningful material.

2.3 Mediating Effect of autonomy support

Students with strong autonomy perform better throughout the semester in their classroom via a 5-item scale developed for this project that showed good reliability in each index. The five items included "Students often get to make decisions about how the task should run", "Students often get choices about how to design that project structure", "We have a lot of discussions", "Students often feel like they get to lead the teaching progress", and "The teacher changes if the plan more interesting for students." Responses were on a 5-point scale from 1 to 5. Previous research [1] demonstrated this measure's predictive validity with both observed student engagement and students' self-reported engagement.

2.4 Mediating Effect of competence

We evaluated students' general views on their academic abilities through three indicators extracted from the results of the self-regulated learning ability test. The students answered with a five-point system (1 = totally agree, 5 = disagree). These three indicators are: "I don't need help, I can definitely accomplish the task", "I am fully competent, but I would like to cooperate", "I am sure I can master the skills taught in class this year", "I can't accomplish without help".

3. Multi-Mediator linear regression analysis

When there are multiple linear relationships between dependent variables and independent variables, the multiple linear regression model can be used to describe the relationship between them.

The simple linear regression model only considers the influence of single mediator. In fact, there is often more than one factor affecting the dependent variable, and there may be more than one influencing factor, which requires the use of multiple linear regression analysis. The difference between multiple linear regression and multiple linear regression depends on the number of dependent variables or independent variables. Multiple linear regression refers to a linear regression model containing two or more independent variables, while multiple linear regression refers to a linear regression model containing two or more dependent variables. Therefore, the multiple linear regression model is described as equation (2):

$$Y = \sum_{i=1}^4 b_i M_i + \sum_{i,j=1}^4 M_i M_j + e \quad (2)$$

Here, $M_i M_j$ represent each mediating variable, When $i=j$, $M_i M_j = 0$.

We utilized SPSS to simulate the linear regression analysis of Mediators. In the screening of multiple linear regression independent variables, we follow the rules below:

(1) leaving useful independent variables in the model, eliminating useless independent variables;

- (2) the model should have a higher predictive value;
- (3) the model should be simple, that is, the independent variables of the equation should be as few as possible.

According to equation (2), analysis on SPSS includes Measurement of the degree of correlation between individual variables and individual dependent variables. The dataset sampled by this research is fed into SPSS database [3].

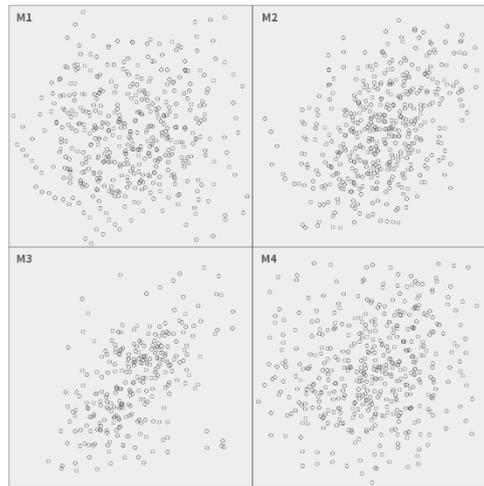


Figure 1. Multilevel linear regression analysis of M1, M2, M3, M4 correlation with Y
 Figure 1 shows the Multilevel linear regression analysis uses matrix scatter plot. The proportion of the influence degree of each mediating variable to the total influence degree is 12%,28%,42%,18%, respectively.

Table 1 The proportion of the influence degree of each variable to the total influence degree

Mediating factor	R	R Square	Std. Error of the Estimate
M1	0.126	0.0158	14.127
M2	0.283	0.0566	11.254
M3	0.425	0.1806	15.684
M4	0.186	0.0345	13.258

R, R Square, and Std. Error of the Estimate represent "complex correlation coefficient", "determination coefficient", "residual standard deviation" respectively. The larger the R value is, the closer the linear regression relationship is. R Square represents the proportion of the total variation of dependent variable Y that can be explained by independent variables in the regression model. The larger the R Square, the better. In linear regression model, R is equivalent to the correlation coefficient between independent variable and dependent variable; R square is the square of R, which means how much proportion of dependent variable variation can be explained by independent variable.

4. Discussion

The multiple linear regression analysis proposed in this paper can be used to test the effects of some intermediaries and the overall effects. Because the error rate is taken into account, the program is superior to a single test method. In addition, the analysis is simple and feasible with less calculation.

Based on previous studies^[1] on the role of teacher emotional support in motivating and attracting students, we tested whether these associations were explained by this classroom convey. The student's final outcome documents show that their autonomy and teammate relationship partly explain the positive change of students' motivation and behavior participation in emotionally supportive classrooms.

5. Conclusion

Multiple mediating variables were used to analyze the relationship between students' learning outcomes and learning initiative, team members, teachers' emotional support and learning ability in a school year. When teachers are observed to be more emotionally supportive at the beginning of the school year, college students' motivation to participate in teaching tasks increases. College students who get more emotional support earn more opportunities for self-determination in their daily tasks, and have more positive relationships with their peers. The indirect effects of mediators on 460 college students' learning outcomes show that teachers' emotional support and teammate relationship have significant mediating effects on students' participation and motivation.

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