The Empirical Research on the Impact of Academic Achievement of College Students on Innovative Behavior

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Abstract. The purpose of this research is to examine the effect of academic achievement on innovative behavior and to examine the mediating role of creative self-efficacy (CSE) and moderating role of tolerance of ambiguity. The sample consisted of 341 college students in China. The statistical analysis was conducted using spss23.0 and Mplus8.3 software and through multiple linear regression analysis and bootstrap analysis to test the research hypotheses. The results indicated that academic achievement positively related to CSE and innovative behavior, CSE mediates the relationship between academic achievement and innovative behavior, tolerance of ambiguity moderates the relationship between academic achievement and innovative behavior, tolerance of ambiguity moderates the relationship between academic achievement and CSE.

1. Introduction

In today's rapid economic and social development, "change is the only constant", and the business environment of enterprises in various industries is becoming increasingly complex. Innovative talents are undoubtedly the most scarce strategic resources of an enterprise. The creativity and innovative behavior of employees are the key driving force for enterprises to adapt to environmental changes and continue to innovate to accelerate development. College graduates are an important supply of enterprise human capital. Gathering innovative talents is a key part of promoting development for enterprises, and the "talent war" has become a true portrayal of enterprise recruitment. However, the selection of high-achieving college students is a common standard for companies to select talents, and whether this inspection standard can help companies select genuine innovative potential talents is still open for discussion.

On the other hand, the cultivation of students’ creativity is the common educational goal of all countries in the world. At present, in China an important criterion for the quality of talents in higher education institutions is the academic achievement of students. At the same time, in academia, more and more scholars focusing on how to cultivate high-quality talents who with rich academic achievements. Academic achievement is the most important element of college training, but there is still a certain distance from cultivating college students with rich academic achievements to cultivating innovative talents. So, will college students with high academic achievement have more innovative behaviors? Can companies recruit college students with high academic achievements to meet the company's demand for innovative talents? It is necessary to examine the effect of
academic achievement on innovative behavior. It cannot be ignored that innovation activities often have strong uncertainties and ambiguities. Individuals’ tolerance for uncertainty, complexity, and ambiguity in the innovation process may affect their belief in innovation. Therefore, will people who like to avoid uncertainty in their personal characteristics affect their motivation for innovation and their innovative behavior?

Therefore, exploring the relationship between academic achievements and innovative behaviors has important practical significance for the selection of high-quality talents with real innovation potential and the adjustment of the training methods of universities. Based on this, there is no research on the relationship between academic achievements, tolerance of ambiguity, and their innovative behavior. Therefore, this study intends to take college students as the research object, select the four variables of academic achievement, CSE, innovative behavior and tolerance of ambiguity, to discuss the mechanism between college students’ academic achievement and their innovative behavior through literature analysis and empirical methods.

2. Theoretical Background and Model

2.1. Academic Achievement and Innovative Behavior

In this study, academic achievement is divided into three dimensions: professional accomplishment, core competence, and academic performance, which fully reflects the accumulation of knowledge and skills of college students during the school period, and is also a manifestation of learning ability and effort. Sternberg and Lubart \[1\] pointed out in their research that knowledge is one of the six resources that individuals rely on to achieve creative goals. Amabile \[2\] also pointed out that one of the main influencing factors of creative behavior is various knowledge and skills related to personal profession, which will directly affect the appropriateness and correctness of innovative ideas. Academic achievement mainly reflects the mastery and application ability of college students' professional knowledge, which shows that college students not only need to digest and absorb the theoretical knowledge of textbooks, but more importantly, apply the knowledge they learn to practice. When college students use their accumulated knowledge and skills, they can stimulate their awareness of their own resources, prompt them to overcome obstacles and difficulties that may be encountered in the innovation process, and then prompt them to implement innovative behaviors. It can be seen that when a college student has rich academic achievements, his sufficient knowledge, skills, critical thinking ability, and multiple perspectives are important resources for him to achieve innovative behaviors.

Hypothesis 1: The academic achievement is positively related to innovative behavior.

2.2. The Mediating Effect of Creative Self-efficacy

Academic achievement is the final result of the knowledge and skills acquired by college students through long-term study. The formation of CSE comes from the individual's cognition and judgment of their own innovative ability, more specifically, the individual's judgment and belief in whether they can use their own skills to complete a specific innovation activity. An individual’s effectiveness expectations are a key factor that affects their innovative self-efficacy\[3\]. For example, the knowledge, skills, and innovative thinking that an individual possesses to complete an innovation task will affect his or her own ability judgment\[4\]. Another important source of CSE is the individual's expectations of innovation results. When an individual has more resources, it may
stimulate his sense of control, that is, thinking he can control the process and results of something. Mastering sufficient innovation resources can enhance the individual’s positive awareness of innovation, for example, Guo et al. [5] mentioned in the review study that the level of education among personal factors is one of the influencing factors of CSE.

The individual's self-evaluation plays a vital role in its perception, thinking and behavior. Self-efficacy is the cognitive variable that is most closely related to human behavior[6], it can encourage people to actively and purposefully regulate their behavior, specifically to innovation Context, it can be considered that this provides an important basis for the positive relationship between CSE and innovative behavior[4]. When an individual believes that he can control the situation and is highly confident in his ability to accomplish goals, the individual will show a high level of self-efficacy and is more likely to apply their own skills. When college students have a high degree of confidence in their ability to innovate, they are more likely to grasp the available resources in their study and life, and are not afraid of the failure that innovation may bring, and are good at summing up experience from failure and generating more creativity Ideas and implement them.

Hypothesis 2: The creative self-efficacy is playing a mediating role between academic achievement and innovative behavior.

2.3. The Moderating Effect of Tolerance of Ambiguity

Tolerance of ambiguity is a personality trait that emphasizes the individual's acceptance of ambiguous, uncertain or inexperienced new situations[7]. Tegano [8] believes that the personality trait of ambiguity tolerance has a very important impact on individual creativity, which can promote the implementation of individual creative behavior and the individual’s creative achievements. Not only that, he also emphasizes that individuals who can not only tolerate ambiguous situations but also regard them as challenges will prefer activities such as discovering problems, solving problems and rehearsing afterwards, and will not draw conclusions to things too early. At the same time, many scholars have considered the influence of personality characteristics on people's subjective cognition in their research. Martinko et al. [9] pointed out that the individual's own characteristic factors will affect the process of information interpretation, that is, people with different individual characteristics face the same situational factors (such as innovative situations). There will also be certain differences in the process of judgment and processing, and ultimately different cognitive effects will be obtained.

Hypothesis 3: The tolerance of ambiguity is playing a moderating role between academic achievement and creative self-efficacy. When college students’ ambiguity tolerance is high, the positive relationship between academic achievement and CSE will increase. When college students’ ambiguity tolerance is low, the positive relationship between academic achievement and CSE will be weaken.

3. Methods

3.1. Sample and Procedure

In this study, data were collected by questionnaire survey, and the respondents were undergraduates and postgraduates and a small number of doctoral samples from Nanjing University of Aeronautics and Astronautics, Northwest University, and Xi’an University of Architecture and Technology. The measurement of related variables is mainly based on the mature scale studied at home and abroad.
In order to ensure the reliability and validity of the scale, the scale selected from the English literature was strictly translated and retranslated. This study distributed questionnaires by electronic questionnaire. A total of 372 questionnaires were collected, and after eliminating invalid questionnaires, 341 valid questionnaires were left, with an effective recovery rate of 91.6%.

3.2. Measure

Academic achievement: we measured academic achievement with 13-item scale developed by Bao and Zhang\textsuperscript{[10]}. Cronbach's alpha coefficient was 0.787. Creative self-efficacy: we measured CSE with 4-item scale developed by Tierney and Farmer\textsuperscript{[11]}. Cronbach's alpha coefficient was 0.829. Innovative behavior: we measured innovative behavior with 5-item scale developed by Liu and Shi\textsuperscript{[12]}. Cronbach's alpha coefficient was 0.838. Tolerance of ambiguity: we measured tolerance of ambiguity with 13-item scale developed by McLain\textsuperscript{[13]}. Cronbach's alpha coefficient was 0.878.

Control variable: Previous studies have pointed out that gender, age, grade, place of growth, major, participation in innovative courses, other factors are considered to be the closely related to the variables discussed in this study.

4. Results

4.1. Descriptive Statistics

It can be seen from Table 1 that academic achievement is significantly positively correlated with innovative behavior ($r=0.334$, $p<0.010$) and CSE($r=0.451$, $p<0.010$); CSE($r=0.784$, $p<0.010$) has a significant positive correlation with innovation behavior. Obviously from the results, academic achievement can explain CSE, and CSE can explain innovative behavior, theoretical expectations are supported, and hypotheses are initially supported.

| Variables                  | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10  |
|----------------------------|------|------|------|------|------|------|------|------|------|-----|
| Gender                     |      |      |      |      |      |      |      |      |      |     |
| Age                        | 0.227**|      |      |      |      |      |      |      |      |     |
| Grade                      | 0.270** 0.884** |      |      |      |      |      |      |      |      |     |
| Place of growth            | 0.104 | -0.125*  -0.087 |      |      |      |      |      |      |      |     |
| Major                      | -0.345** -0.407** -0.406** 0.004 |      |      |      |      |      |      |      |      |     |
| Innovative courses         | 0.050 | -0.123*  -0.071  -0.073 0.043 |      |      |      |      |      |      |      |     |
| Academic achievement       | -0.143** 0.051  -0.115* 0.087 0.051 0.225** |      |      |      |      |      |      |      |      |     |
| Tolerance of ambiguity     | -0.037 | -0.082  -0.135* 0.045 0.034 0.021 0.082 |      |      |      |      |      |      |      |      |     |
| creative self-efficacy     | -0.117* 0.038  0.052 0.097 -0.019 0.100 0.451** 0.383** |      |      |      |      |      |      |      |      |     |
| innovative behavior        | -0.012 0.036  0.049 0.041 -0.092 0.101 0.334** 0.429** 0.784** |      |      |      |      |      |      |      |      |     |

4.2. Confirmatory Factor Analyses

The four-factor model has the best fit index, which is sufficient to indicate that the questionnaire has
high overall validity and the four research constructs are independent of each other. The specific results are shown in Table 2.

| Models                  | Factor                        | $\chi^2$/$df$ | RMSEA | CFI  | TLI  | SRMR |
|-------------------------|-------------------------------|---------------|-------|------|------|------|
| four-factor model       | $AA; TA; CSE; IB$             | 1.861         | 0.050 | 0.908 | 0.897| 0.058|
| three-factor model      | $AA; TA+CSE; IB$              | 2.645         | 0.069 | 0.823 | 0.804| 0.101|
| two-factor model        | $TA; AA+CSE+IB$               | 2.765         | 0.072 | 0.810 | 0.789| 0.081|
| one-factor model        | $AA+TA+CSE+IB$                | 3.671         | 0.089 | 0.716 | 0.681| 0.111|

Note: $n=341$; AA means academic achievement, TA means tolerance of ambiguity, CSE means creative self-efficacy, IB means innovative behavior. "+" means a combination of variables.

4.3. Test of Hypotheses

This study uses CSE and innovative behavior as dependent variables to perform multiple linear regression to test the impact of academic achievement on innovative behavior, the mediating role of CSE, and the moderating role of tolerance of ambiguity. When testing the mediation effect, the study used the bootstrap method.

| Variables            | CSE | Innovative behavior |
|----------------------|-----|---------------------|
|                      | Modle1 | Modle2 | Modle3 | Modle4 | Modle5 | Modle6 |
| Gender               | -0.181** | -0.085 | -0.102* | -0.071 | 0.004  | 0.072  |
| Age                  | 0.012   | 0.070   | -0.014  | -0.015  | 0.031  | -0.026 |
| Grade                | 0.093   | -0.055  | 0.086   | 0.052   | -0.063 | -0.020 |
| Place of growth      | 0.135*  | 0.072   | 0.065   | 0.060   | 0.011  | -0.047 |
| Major                | -0.045  | -0.071  | -0.087  | -0.107  | -0.127*| -0.071 |
| Innovative courses   | 0.129*  | 0.020   | 0.035   | 0.115*  | 0.030  | 0.014  |
| Academic achievement | 0.438** | 0.370** | 0.343** | 0.343** | -0.008 | 0.800** |
| Creative self-efficacy|        |          |         |         |        |        |
| Tolerance of ambiguity| 0.306** |          |         |         |        |        |
| AA*TA                | 0.192** |          |         |         |        |        |
| $R^2$                | 0.054   | 0.220   | 0.373   | 0.027   | 0.128  | 0.627  |
| $F$                  | 3.134** | 13.385** | 21.874** | 1.534  | 7.011** | 69.882** |

Note: N=341. *p<0.05, **p<0.01. AA means academic achievement, TA means tolerance of ambiguity.

Paper takes innovation behavior as the dependent variable, and successively introduces control.
variables and academic achievement as independent variables, constructing Model 4 and Model 5, respectively, the regression results of the control variables on innovation behavior and the regression results of academic achievement on innovation behavior. According to the table 3, we can see, after adding control variables such as gender, age, and grade, there is a significant positive correlation between academic achievement and innovative behavior ($\beta=0.343$, $p<0.01$; model 5), so H1 was fully supported. After adding CSE, there is a significant positive correlation between CSE and innovation behavior ($\beta=0.800$, $p=0.01$; Model 6), and the positive correlation between academic achievement and CSE is significant ($\beta=0.438$, $p<0.01$; Model 2), and the positive correlation between academic achievement and innovation behavior becomes insignificant ($\beta=-0.008$, $p>0.01$. Model 6). From this point of view, CSE plays a completely mediating effect between academic achievement and innovative behavior. This study assumes that the mediating role of CSE is supported. This study also used bootstrap method to test the mediation effect. The bootstrap re-sampling value is set to 5000 times, and the mediating effect of CSE between academic achievement and innovation behavior is 0.893, and the confidence interval(95%) of bootstrap=5000 is [0.3754,0.6362], indicating that the mediating effect is significant, so H2 was fully supported.

Model 3 in Table 3 is the regression result of the adjustment test. If the coefficient of the adjustment item is significant, it means that the moderate effect exists. The results show that the interaction coefficient between academic achievement and tolerance of ambiguity has a significant positive correlation with CSE (model 3, $\beta=0.192$, $p<0.01$). Therefore, the moderating effect of tolerance of ambiguity was supported by data.

In order to better test the moderating effect of tolerance of ambiguity, this paper takes the positive and negative one standard deviation of the mean value of the moderating variable into the regression equation, and draws the moderating effect diagram, as shown in Figure 1.

![Figure 1. Moderating effect of tolerance of ambiguity.](image)

### 5. Discussion

The empirical results based on 341 college students survey data show that academic achievement is significantly positively correlated with innovative behavior. Creative self-efficacy plays a mediating role between academic achievement and innovative behavior. The tolerance of ambiguity strengthens the positive influence of academic achievement on CSE. The higher the tolerance of ambiguity, the higher the mediating effect of tolerance of ambiguity on academic achievement and CSE.
5.1. Theoretical Contribution and Practical Implications

From the perspective of the accumulation of knowledge and skills of college students in school, the generation of innovative behavior is discussed, which provides a new perspective for subsequent scholars' empirical research on innovative behavior. The results of the study confirmed that tolerance of ambiguity played a positive role in promoting the influence of academic achievement on CSE.

It provides new ideas for the selection criteria and training methods of innovative talents in enterprises. Universities should strive to improve the evaluation system of students' academic achievement, provide innovative support, and shape students' character. Students should strive to consolidate their academic achievements, embrace complexity and uncertainty, and continuously improve their sense of innovation.

5.2. Theoretical Contribution and Practical Inspiration

In this study, the choice of pre-dependent variables and moderating variables is biased towards personal factors without considering environmental factors, and personal attitudes and behaviors are not only related to their own resources but also affected by the external environment. Therefore, in future research, the influence of environmental factors on the innovation ability and innovative behavior of college students can be considered, which can make the research model more three-dimensional and more convincing.

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