

The Impact of Curriculum Teaching Reform on Graduate Students' Innovation and Entrepreneurship

Yanguang Xu^{1(✉)}, Wei Ye², Xuebo Chen^{3(✉)}, and Qiubai Sun³

¹ School of Electronics, Information Engineering, University of Science, Technology Liaoning, Anshan 114051, China
shine216831@sina.com

² Faculty of Science and Electronic Information, Guangdong University of Petrochemical Technology, Maoming 525000, China
yeweill127@163.com

³ Graduate School of University of Science and Technology Liaoning, Anshan 114051, China
xuebochen@126.com, lnkdsqb@ustl.edu.cn

Abstract. In order to improve the innovation and entrepreneurship ability of graduate students, a questionnaire survey was carried out on the 6 graduate students in the course of “linear system theory and design”. Using SPSS 19.0 analysis and verification of the data collected, the use of structural equation model and factor analysis method to study the impact of teaching reform on innovation and entrepreneurship. And put forward student participation as a latent variable which include a graduate reading related literature research, the involved in the relationship between the degree of innovation and entrepreneurial achievement output and research students. The research shows that the reform of teaching methods, teacher team construction and students participation, have great direct positive impact on innovation and entrepreneurial achievement output. Graduate reading related literature has an indirect positive impact on the output of innovation and entrepreneurship. On this basis, the corresponding countermeasures and suggestions are put forward to improve the ability of innovation and Entrepreneurship of metallurgical colleges and universities.

Keywords: Innovation and entrepreneurship · Teaching reform · Research reading · Structural equation model · Factor analysis

1 Introduction

The innovative education of graduate students is the new normal condition of the development of higher education at present, especially the metallurgical colleges and universities as an important base for the cultivation of innovative talents in our country. In the part of postgraduate training, not only to master the basic skills of the professional, pay more attention to the training of graduate students innovation ability, but also to increase the employment, enhance the market competitiveness of modern

enterprises to meet the demand for talent. Therefore, it is very important to pay attention to cultivating the innovation ability of graduate students in the teaching reform of metallurgical universities.

After analyzing the current research found that in the process of research on how to cultivate the innovation ability of graduate students, most scholars have a consensus on the necessity of cultivating the innovation ability of graduate students, but there are few studies on factors influence way concerned to enhance the innovation ability of graduate students. For example, the paper [1] summarizes the main obstacles of influencing the innovation and entrepreneurship education, and shares the corresponding reform and practical experience. In the paper [2], the author paid attention to the necessity of developing the innovation ability of graduate students in the teaching reform of higher vocational education, and put forward some thoughts on the reform of higher vocational education and teaching in higher vocational colleges. Literature [3] has been explored in several aspects, such as personnel training mode, the construction of teachers' team, the construction of practical conditions and the construction of innovative entrepreneurial atmosphere. Paper [4] proposed reform of postgraduate courses, to eliminate the irrational factors, construction of innovative talents training is the key to improve the innovative ability of graduate students.

In fact, there are many factors that influence the innovation ability of graduate students and the output of innovation and entrepreneurship. In this paper, by using the structural equation model analysis method, this paper probes into the influence of the teaching reform on the innovation ability of graduate students in metallurgical universities, and the paper also puts forward the graduate student participation as a potential variable which contains the reading factors of graduate students. This paper studies the relationship between the output of innovation and entrepreneurship and the participation of graduate students, and puts forward some countermeasures and suggestions on the cultivation of graduate students' innovation ability.

2 Research Methods and Sample Selection

2.1 Research Methods

This research adopts the design of the questionnaire and the scale to get the data, using structural equation model to establish the model, quantitative analysis and empirical research. Specific to the 6 graduate students for the survey, the reform of the curriculum teaching and the impact of graduate student participation on innovation and entrepreneurship were investigated, and the impact of the factors of graduate innovation and entrepreneurship were quantitatively analyzed. 16 measure of influence factors is designed, as 16 exogenous observed variables were constructed four latent variables; of innovation and entrepreneurial achievements and research students to participate in the investigation and analysis of 3 measurements were designed, the observed variables to explain two students latent variables, as shown in Table 1, and for the relationship

Table 1. Latent variables and observed variables

Latent variable	Symbol	Observation index variable	Latent variable	Symbol	Observation index variable
Construction of tutor team	X ₁	Pay attention to the study and practice of the combination of graduate students	Reform in teaching methods	X ₁₃	Adopt the "seminar" teaching mode and cultivate the innovation ability of graduate students
	X ₂	The implementation of personalized management for graduate students		X ₁₄	Related engineering practice, training graduate students to solve practical problems
	X ₃	Special training for the teachers to guide the innovation and Entrepreneurship		X ₁₅	Establish a sound assessment mechanism, strict quality of teaching
	X ₄	Formulate relevant incentive policies		X ₁₆	Application of information technology
	X ₅	Employ enterprise instructors to guide graduate students entrepreneurial training and Practice	Innovation and Entrepreneurship	Y ₁	Paper publication level
Reform of examination mode	X ₆	Basic theory examination		Y ₂	Number of papers published
	X ₇	Practice teaching assessment		Y ₃	Number of patent applications
	X ₈	Innovation capability assessment			
Reform of teaching content	X ₉	Orientation and curriculum objectives of the teaching curriculum in the postgraduate training program	Graduate student participation	Y ₅	Interaction with mentors

(continued)

Table 1. (continued)

Latent variable	Symbol	Observation index variable	Latent variable	Symbol	Observation index variable
	X ₁₀	Knowledge module sequence and corresponding period		Y ₆	Discussion among students
	X ₁₁	The key points, difficulties and solutions of the course.		Y ₇	Graduate reading related literature
	X ₁₂	The design idea and effect of practical teaching activities			

between the latent variables established structural equation model. In this study, the use of statistical software SPSS 19.0 data entry, structural equation modeling software lisrel8.7 compilation path graph, using maximum likelihood estimation to obtain the parameter estimation results, and goodness of fit for evaluating the operation result.

2.2 Sample Selection

In order to be able to graduate students in simple and scientific measurement, the accuracy and the validity of the numerical and statistical results, this study carried out questionnaire survey in my school graduate students. a total of 361 questionnaires were issued, and all recovered and effective. The questionnaire is divided into 5 points, the middle value is 3 points, the lowest is 1 points. The composition of the sample data is shown in Table 2.

Table 2. Sample data constituting

Grade	Number of people	Proportion
2008	50	13.9%
2009	71	19.7%
2011	65	18.0%
2012	66	18.3%
2013	75	20.8%
2014	34	9.4%

3 Establishment and Evaluation of Structural Equation Model

3.1 Construction of SEM Model

According to the latent variables and the observation index variables in paper [5], the initial model of the data is set up and the structure equation is

$$\begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} = \begin{bmatrix} 0 & \beta_{12} \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \end{bmatrix} + \zeta \quad (1)$$

Where η_1 expresses innovation and entrepreneurship, η_2 represents student engagement that denotes internal latent variables; ξ_i ($i = 1, 2, 3, 4$) indicates latent exogenous variable; β_{12} indicates the influence of the endogenous latent variables, γ_{ij} ($i = 1, 2; j = 1, 2, 3, 4$) indicates how latent exogenous variables influence endogenous latent variables, ζ is the internal residual matrix of latent variables.

Exogenous latent variable measurement equation:

$$X_i = \lambda_{ik}^x \xi_k + e_i \quad (2)$$

Where X_i ($i = 1, 2, 3, \dots, 16$) denotes external observation variable; ξ_1 represents construction of tutor team, ξ_2 represents reform of examination mode, ξ_3 expresses reform of teaching content, ξ_4 expresses reform in teaching methods that represents external latent variables; λ_{ik}^x ($k = 1, 2, 3, 4$) is the factor loadings that i -th observation variable on the k -th external latent variables; e_i represents measurement errors.

Endogenous latent variable measurement equation:

$$Y_j = \lambda_{jl}^y \eta_l + d_j \quad (3)$$

Where Y_j ($j = 1, 2, \dots, 7$) observe internal variable; η_1 represents innovation and entrepreneurship, η_2 represents student engagement that represents internal latent variables; λ_{jl}^y ($l = 1, 2$) is the factor loading that j -th observation of internal variables on the latent variables; d_j ($j = 1, 2, \dots, 7$) represents measurement errors.

We can build models by the software LISREL according to SEM observation equations and structural equation and then the path coefficients and load factors are normalize by the means of MLE (maximum likelihood estimation), the result are shown in Fig. 1.

3.2 Overall Fitting Evaluation of SEM Model

χ^2/df , RMSEA, CFI, NFI, IFI and other inspection [6] are selected in this paper as the main parameters to consider the goodness of fit of the model. After the operation of

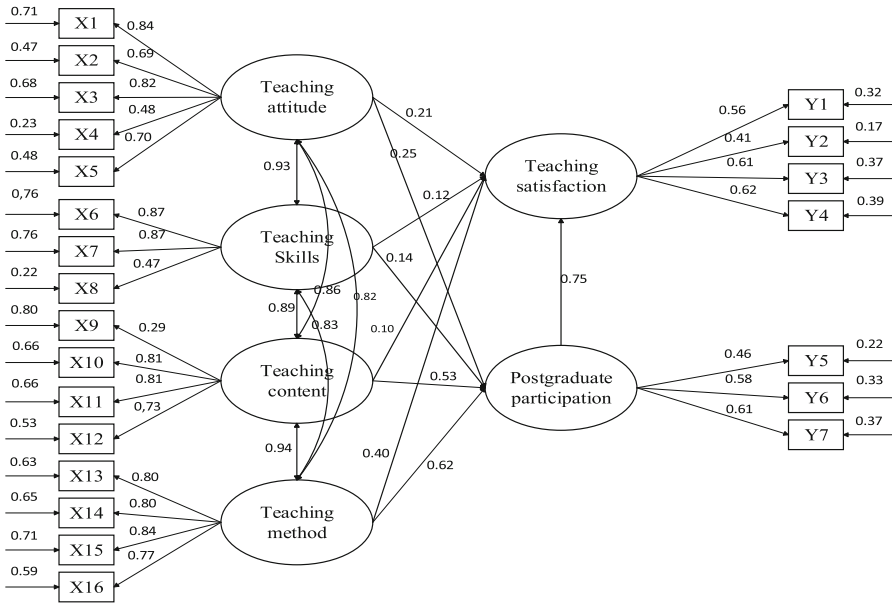


Fig. 1. Standardized SEM roadmap

Table 3. Fit index of model

Index of goodness of fit	χ^2/df	RMSEA	CFI	GFI	IFI
Estimated value	1.88	0.055	0.942	0.908	0.942
Fitting standard	≤ 2	≤ 0.08	≥ 0.9	≥ 0.9	≥ 0.9

software LISREL, you can get various goodness of fit index parameter values estimated by SEM model, as is shown in Table 3.

3.3 Validity of Indicators

Standardized estimated parameters for each latent variable can not only effectively reflect its relevance against the latent variables, but also reflect power that the latent variable explain the index.

From Fig. 1, 11 standardized factor loadings on 23 indicators of five latent variables not less than 0.71, according to the evaluation principles of content validity in structural equation, (the multiple correlation coefficients or factor loadings squared R2 is greater than 0.5 if standardized factor loadings greater than 0.71), which means that the latent variables can explain more than 50% problems corresponding to the scale.

3.4 Composite Reliability of Latent Variables

For SEM, the evaluation of the structural model need to test the reliability of potential variables, this test is called composite reliability [7], composite reliability refers to the degree of consistency between latent variable and its corresponding observed variable, the following statistical indicators are used:

$$CR = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum (\theta_i)} \quad (4)$$

Where CR represents combination of reliability, λ_i represents normalized factor loading parameters that observed variables against the latent variables, θ_i is the measurement error of observed variables.

Evaluation of CR: 0.90 represents outstanding; 0.80 represents very good; greater than 0.60 indicates acceptable.

As can be seen from Table 4, four in five latent variables' composite reliability reached or greater than 0.80, far greater than 0.6 (normally required value), indicating that degree of consistency of measured variables and latent variable in this study is still relatively high, thus it can better explain and support its corresponding latent variable.

Table 4. Combined reliability of latent variables

Latent variable	Composite reliability
Construction of tutor team	0.83
Reform of examination mode	0.74
Reform of teaching content	0.78
reform in teaching methods	0.80
Innovation and entrepreneurship	0.79
Graduate student participation	0.75

4 Model Results Analysis

4.1 The Comparison of the Results of Innovation and Entrepreneurship

As can be seen from Fig. 1, the reform of teaching methods is the biggest impact on innovation and entrepreneurship, and the factor load is 0.40. The teaching method reform is reflected by 4 observation variables X13–X16, the factor load of 4 observation variables in the teaching method reform is 0.80, 0.80, 0.84, 0.77. So the teaching method reform has a great influence on the innovation ability of graduate students. On the one hand, in the classroom using “seminar” teaching mode, so that students also participate in classroom teaching, teachers and students communicate with each other, the classroom atmosphere is active, in the discussion to complete the teaching task. Training of graduate students' autonomous learning ability and innovation ability, give full play to the initiative and initiative of graduate students, to help and guide the graduate students to effectively carry out autonomous learning. On the other hand,

associated with the content of classroom teaching and the practical engineering systems, not only contribute to the understanding and learning of course abstract concepts and theory of knowledge, but also expand the horizons of students, to improve the ability of graduate students to solve practical engineering problems, the application of modern educational information technology can not only improve the teaching efficiency, and can effectively stimulate the learning interest of the graduate students, to strengthen the students' innovation consciousness and practical ability cultivation.

The role of mentor team building on innovation and entrepreneurship is the second, the factor load is 0.21. The construction of the tutor team consists of 5 observation variables X1–X5 to reflect the 5 observation variables in the construction of the teacher's factor load 0.83, 0.69, 0.82, 0.48, 0.70. From these data, we can know that, in addition to fourth, the other four of the construction of the contingent of instructors are higher. From this view, the construction of the team of teachers in the construction of innovative business results have a great impact on the output. Teacher pay attention to postgraduate study and practice of combining, the implementation of personalized management, not only improve the graduate of enthusiasm and ability of innovation and entrepreneurship, and to improve the employment of graduate students to the positive role in promoting. Mentors play a guiding role in graduate and graduate innovation and entrepreneurship, so that graduate students in practice and less detours, to achieve greater results.

4.2 The Influence of the Degree of Participation of the Graduate Students

The reform of teaching content and teaching method reform have a great impact on graduate students' participation. The reasons are the following: first, with the development of society, science and technology progress, the social demand for talent is not only rigidly adhere to the quantity, but also requires a qualitative leap. Graduate students to adapt to the needs of the community, to broaden their knowledge, to lay a good foundation for future employment, so the depth and breadth of the content of the classroom teachers have higher requirements. Second, with the improvement of graduate education, graduate pay more attention to the development of their own quality, but is not limited to the limited knowledge in the textbook. Third, the progress of the times need to graduate students learn more extensive knowledge, and completed in the classroom teaching of the work is difficult, which requires teachers in the teaching process can be focused and explain clearly. Based on the above three reasons, the teaching content of practice and learning life has a greater role in guiding.

The four factors of the reform of teaching methods are the factor load of 0.80, 0.80, 0.84, 0.77. According to the results of analysis can be seen in classroom teaching process, pay attention to the knowledge teaching and ability training combination, inspiring education, theory and practice combination, cultivating interest teaching method can stimulate the learning interest of the graduate, enhance participation in classroom teaching. The reason, teaching methods mentioned above changed in the past teaching "cramming method of teaching", enable students to actively participate in them, so that the entire teaching process in a lively atmosphere, students can in a relaxed environment of middle school to more knowledge.

4.3 The Impact of Graduate Student Participation on Innovation and Entrepreneurship

The factor load of graduate students' participation in innovation and entrepreneurship is 0.75. In particular, the research on the impact of reading related literature on innovation and entrepreneurship is the biggest. The reason has the following two points: on the one hand reading related literature the good theoretical knowledge and actual unifies, break through the traditional teaching theory, for example [8], by reading the metallurgical automation project case analysis can let the students in the greatest degree of understanding to the application of the linear system theory and design" course in engineering, classroom feedback, allow graduate students to apply what they have learned. On the other hand, in the process of reading, the graduate students have a comprehensive understanding of all aspects of the relevant issues and seek to solve various ways and methods of solving the problems. In addition, graduate students to carry out reading is an essential part of the research and innovation activities. By verifying the system or application to solve the problem, what kind of thinking or technical way and the author of the technical ideas of the similarities and differences, it is conducive to the training of the researchers' thinking mode and strengthen the sense of innovation.

Teachers' and students' interaction and graduate student academic exchange is an integral part of, on the one hand, the interaction between teachers and students to understand the tutor graduate study, research progress, for the next step of work are for guidance, on the other hand the communication between graduate students to graduate opportunities offer a free discussion, to express their views, to solve the problem of different research direction, it plays an important role in training graduate students of team cooperation spirit and the ability of research and innovation.

5 Countermeasures and Suggestions

5.1 Improve the Structure of the Tutor Team

Improve the structure of the tutor team according to the subject need to be composed of tutor, tutor group, respectively, in charge of graduate teaching, practice and academic degree thesis guidance. And large metallurgical enterprises, scientific research institutes, the establishment of the enterprise in the enterprise education innovation center, the counterpart research institutes as a graduate training base. Hire the front line of production and application of the first technology and technology backbone as the studying part-time tutor, let the students have more chances to contact with industry, to understand the actual needs of the enterprise economic development and the progress of science and technology, create the actual training and training atmosphere close to. Establishment of effective competition, dynamic management and tracking mechanism, each completed a session of postgraduate training mission, to deal with the culture effect analysis and evaluation, summarize and popularize the successful experience, improve the existing teacher training high-level innovative talents, so as to ensure the quality of graduate education.

5.2 Reform of the Form of Assessment

The reform of the form of assessment is also an important factor that can not be ignored in teaching satisfaction. The assessment is divided into basic theory, practical ability and innovative ability assessment. Assessment form and content are associated with the process of teaching, focus on examination of students to master the basic theory and system expertise degree; to grasp the direction of the theoretical development of the and the application of the theory and method of solving practical problem.

5.3 The Reform of Teaching Methods

The reform of teaching methods as the impact of innovation and entrepreneurial achievement biggest factors and need extra attention, break through the traditional conventional teaching methods, to train graduate students autonomous learning ability and innovation ability as the goal, give full play to the graduate student learning autonomy and initiative, help and guide the students effectively to carry out autonomous learning, respect graduate of the dominant position of students, increase the learning interest, training of graduate students innovation ability. By correlating the content of classroom teaching and the practical engineering systems, not only contribute to the understanding and learning of abstract concepts and theoretical knowledge, but also expand the horizons of students, to improve the ability of graduate students to solve practical engineering problems, earnestly carry out the modern engineering education.

5.4 Strengthen the Research of Reading Education

Strengthen the research of reading education, and help graduate students strengthen reading skills, including the ability to get information, understand the information reading ability, thinking ability, reading ability, reading ability evaluation. It is necessary for graduate students to understand the classification, organization, retrieval and utilization of literature information resources. In particular, it is necessary for graduate students to develop the consciousness and habit of research-based reading.

Acknowledgments. This research reported herein was supported by the NSFC of China under Grant No. 71571091.

References

1. Wang, Z.J., Tan Wei, J.: The reform and practice of improving students' innovation and entrepreneurship ability in food specialty practice. *Light Ind. Sci. Technol.* **12**, 173–174 (2014). (in Chinese)
2. Shao, J.G., Shi, S.Y.: Teaching reform in higher vocational colleges should pay attention to the cultivation of students' innovative ability. *Sci. Technol. Vis.* **14**, 226 (2016). (in Chinese)

3. Li, Z.K.: Practical research on the cultivation of innovative and entrepreneurial ability of college students. *China Electr. Power Educ.* **37** (2013). (in Chinese)
4. Ban, S.: Research on curriculum reform and innovation talent cultivation of master's degree students. *J. Anhui Vocat. Coll. Metall. Technol.* **20**, 48–50 (2010). (in Chinese)
5. Hou, J.T., Wen, Z.L., Cheng, Z.J.: *Structural Equation Model and Its Application*. Education Science Press, Beijing (2004). (in Chinese)
6. Wen, Z.L., Hou, J.T., Marsh, H.: Structural equation model testing and fitting index card square criterion. *J. Psychol.* **36**, 186–194 (2004). (in Chinese)
7. Xu, W.L.: Structural equation model in the reliability test in the application of statistics and information forum 9–13 (2008). (in Chinese)
8. Chen, X.B., Shen, M.X., Xu, S.C.: *Case Analysis of Metallurgical Automation Engineering: Mineral Processing, Sintering, Pellet and Blast Furnace*. Northeastern University Press, Lebanon (2011). (in Chinese)