Analysis of Course "Applied Mathematics" in Postgraduate Education Based on Change of Training Objective

Shuai Liu[1(✉)], Weina Fu[2], and Qiang Li[1]

[1] College of Computer, Inner Mongolia University, Hohhot 010012, China
cs_liushuai@imu.edu.cn
[2] College of Computer and Information Engineering,
Inner Mongolia Agricultural University, Hohhot 010012, China
fuwn@imau.edu.cn

Abstract. During postgraduate education, "Applied Mathematics" is the most important public basic course for most science and engineering majors. However, fusion of applied mathematical theory and academic application is needed to analyze because of current change of training objective in postgraduate education. Therefore, this paper improves the teaching approach of course "Applied Mathematics" in order to press close to current training objective. Firstly, the difference is studied between classical objective which is inclined to theoretical theory and current objective which is inclined to academic application in postgraduate education. Furthermore, based on the difference we analyzed, an improved teaching method based on practical teaching is provided to solve this problem. Finally, experimental results show effectiveness and practicability of proposed method.

Keywords: Postgraduate education · Training objective · Applied mathematics
Academic application · Teaching approach

1 Introduction

Since "State Council of China" promulgates enactment "the regulations of the People's Republic of China on Academic Degrees" in February of 1980, Chinese academic degree has three levels, which are degree of bachelor, master and doctor [1]. Implementation of enactment represents that Chinese degree and postgraduate education system is formally established. The State Educational Commission of China is predecessor of current Chinese Ministry of Education, which is the department to formulate postgraduate education and degree granting regulations of China.

During nearly forty years, there has been a high development of Chinese postgraduate education. However, based on great growth for quantity of postgraduates, many problems have been appeared recently. One significant problem is dislocation between the changes of training objective and classical theoretical inclined teaching approach.

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Earlier, training objective of postgraduate education is to cultivate high level scientific talents, which means most of them will still engage in scientific or social study in their research subject after their degree study. Therefore, classical teaching approach is constructed inclining to theoretical study because of the objective. However, with the increment of postgraduate quantity, a master or doctor degree now is a basic requirement in the senior employment market, which means that training objective of postgraduate education needs to be declined to real application. However, some classic postgraduate courses are facing great challenges because these courses cannot help postgraduates in their future work. Unfortunately, "Applied Mathematics" is such a course that needs to change its teaching approach.

2 Related Works

For years, many scholars, whatever in China or abroad, have researched on this problem. Since the problem became so pronounced, Xie researched construction of a reasonable curriculum system of the postgraduate education at earliest [2]. He researched curriculum designing, update stressing, classification making and individuality emphasizing. Afterwards, many scholars studied postgraduate education of China. Recently, Zhu et al. discussed status of graduate students' creativity and its influence mechanism [3]. Fan studied the cause of "low guiding effectiveness" for master's supervisor [4]. Meantime, Wang and Mao investigate demonstration for self-efficacy of scientific research in master students [5].

Soon afterwards, postgraduate education is also act as a significant study domain in education domain. Buissink-Smith et al. described and considered an initiative that sought to manufacture postgraduate peer-support groups and communities at a New Zealand university [6]. Kazim et al. explored the development of 'dynamic', collaborative and 'real time' pedagogy for teacher education [7]. Adams et al. researched perceptions of the benefits of learner-generated podcasts for supporting postgraduate engineering students in a mathematics-intensive course [8]. Shao et al. studied the training target, basic characteristics and the law of education on graduate students. They insisted that considerable progress has been made in education of degree graduates, and educational deviation correction of professional degree graduate has become an important task of educators [9]. Gemmell et al. described student views on learning from different countries in an online distance learning environment [10].

Recently, Teeroovengadum et al. measured service quality in higher education with a hierarchical model [11]. van der Valk researched quality assurance in postgraduate pathology by trained with regular assessment, monitoring of programs and examination [12]. Ryan and Zuber-Skerritt published their writing to review quality in postgraduate education [13]. Besides, our team is also working hard in this research domain. We studied task driven for mathematical course, investigated inadaptability between theory and application of mathematical course, applied formative evaluation as an effective teaching method, and found specialty directions of course "Applied Mathematics" for students whose majors are computer science [14–17].

The remainder of the paper is organized as follows.

First, we present and analyze the difference between training objectives of classical and current postgraduate education in Sect. 3.

Moreover, in Sect. 4, an improved teaching approach is presented in order to aim the new objective. This improved teaching approach is applied to experiment and analyze the comparison between the postgraduates who have been taught with the provided approach and classical approach.

Finally, Sect. 5 summarizes the main results of the paper.

3 Comparison Between Current and Traditional Training Objective

For years, training objective of postgraduate education is changing with development of economy and higher education. Traditionally, the teaching and training objective of postgraduate education is that postgraduates must master theoretical knowledge in their research domains and establish the foundation for their future research. Therefore, training objective is rationally inclined to theoretical knowledge without practical application. However, training objective is faced to job market today, which makes traditional teaching approach of theoretical courses, such as "applied mathematics", doesn't suit for the training objective. Forasmuch as teaching approach of this course faces problems.

3.1 Difference Between Traditional and Current Training Objective

In fact, the difference between traditional and current training objective can be divided as two cases.

(1) **The difference between knowledge and application**

In this case, difference between knowledge and application shows that the curricular knowledge studied by postgraduates can't be applied into real application to solve the real problems. For example, in traditional teaching approach, instructional objectives of differential equation and difference equation model is that postgraduates can expertly solve the provided differential and difference equation. However, companies' expectance is that they can abstract the problem to equations well, and then solve it. In this case, the postgraduates can't solve the real problems because they don't know how to get the equations.

(2) **The difference between requirement of related courses**

Since the training objective is changed, the expression of difference is also changed. Current objective shows that the postgraduates need to use applied mathematical knowledge to solve the problem from other related courses. More-over, they need to construct mathematical model for problems of other related courses. For example, in current training objective, postgraduate need to know how the filter reaches filtering, meantime, they need to design filters themselves. However, all of these are not required in traditional training objective, which do not need students to use applied mathematics into network, bioinformatics, image processing, pattern recognition or other courses.

In this way, the course "applied mathematics" need to change its teaching approach to reach its task from "to know theoretical knowledge in complex and future study" to "to help postgraduates know what to do in their subjects". So we should know why and how can it be changed.

3.2 Reasons of Difference Between Traditional and Current Objective

During my fourteen years high educational teaching time, with discussion of my teaching team, two reasons is found to lead to this appearance of difference between traditional and current objectives.

(1) **The difference between examined mathematics and applied mathematics**

Before Chinese undergraduates enter postgraduate education, they need to pass a "standard postgraduate examination". However, not all the undergraduates passed the examination can be recommended to postgraduate education, which means they need to get a high score in the examination. In the standard postgraduate examination, higher mathematics is an important examining course. Table 1 is the total score of all examining courses. So we know that 30% of scores are from higher mathematics. To be the hardest course of engineering subjects, higher mathematics is often spent much time by these undergraduates.

Table 1. Distribution of score in standard postgraduate examination

Courses	Higher mathematics	Professional course	Higher English	Politics	Total
Score	150 (30%)	150 (30%)	100 (20%)	100 (20%)	500

Then, in order to gain a better score, many undergraduates put their energy into "higher score", but not "understanding". So when they become postgraduates, their undesirable habits are also bringing into studying. This is not a terrible habits if they were in traditional postgraduate education because they will continue to work on theoretical research. Nevertheless, this will affect postgraduates' future study in current postgraduate education. This is the difference between "examining mathematics" and "applying mathematics".

(2) **The difference between ability of examination and practical application**

Many Chinese postgraduates lacks innovativeness because of examination-oriented education. This makes them to be a good executor but not a good innovator. We don't want to comment education before postgraduate, but we have to know that more postgraduates lack the ability of application in inter-courses. So in practice, many postgraduates can't use mathematics into their own subjects. Actually, they don't know the meaning of applied mathematics. This makes them harder to understand an equation, construct a model or reach a practical application.

4 Revised Teaching Approach by Training Objective

After discuss the comparison between traditional and current training objective in course "applied mathematics", we here present an improved teaching approach, which is in order to solve the problems in this course.

The improved teaching approach is presented as follows.

(1) **Improved training objective**

In classic theoretical teaching, the training objective is always "to accept/comprehend/understand/master the knowledge of some method". But none of them emphasize the usage and employing. So we improve the training objective to "usage/mimicry/creation of knowledge and methods". So that the postgraduates can use the knowledge into their problems.

(2) **Improved teaching approach**

After the training objective is clear, we have to improve the teaching approach. One effective teaching approach is the case-driven teaching approach, which uses many cases to present the process that applied mathematics is used in problems of computer science.

(3) **Improved examining method**

The examining method has to improve when the training objective and teaching approach are improved. Otherwise, examination-driven mechanism forces the postgraduates go back to the classic studying. In our method, we examine postgraduates with some practical work and one written examination. In these practical work, we give the postgraduates huge data, and require them to classify or find rules in the data. In this teaching, the score of practical work is 60% of the final score, and the score of written examination is 40%. It forces the postgraduates to bring their attention to practical application more.

We have used this method into teaching for two years (fall term in 2016-2017 and 2017–2018, see Fig. 1a–b). Then, with comparison of score in fall term during two years, which are in 2013–2014 and 2014–2015, and 2015–2016 (see Fig. 1c), we have Table 2.

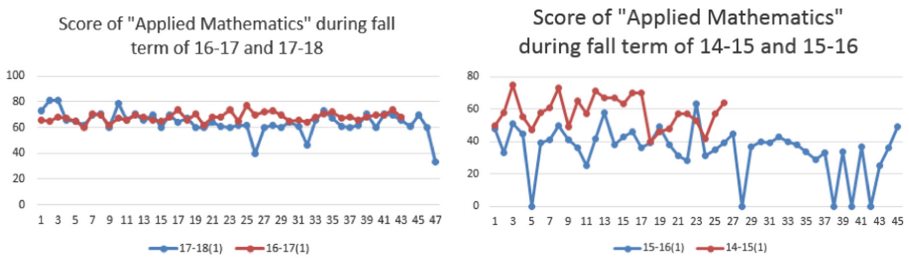

Fig. 1. Score distribution of course "Applied Mathematics" in 2014–2017.

Table 2. Distribution of score in standard postgraduate examination

Term	Mean	hs	ls	dy	dn	dr	ds
14–15	58.46	75	40	0.42	0.24	0.5377	0.1130
15–16	35.20	63	0	0.65	0.32	0.9111	1.2104
16–17	68.16	77	60	0.32	0.08	0.4279	0.1720
17–18	64.15	81	33	0.36	0.18	0.5021	1.1666

Then, in order to research these data, we analyze these scores to get their means, highest scores (hs), lowest scores (ls), degrees of difficulty (dy), differentiation (dn), relative-variance (dr), and degrees of skewness with normal distribution (ds). They are presented in Table 2.

From Table 2, we know that the studying effectiveness is increasing year by year. The dy of terms in 16–17 and 17–18 are lower than in 14–15 and 15–16, which denotes the difficulty of examination is changed to easier. In other words, it denotes that the students learn more knowledge under current training objective. The mean of score of terms in 16–17 and 17–18 are higher than in 14–15 and 15–16, which also denotes that the students can solve more problems under current training objective. The dr of terms in 16–17 and 17–18 are also lower than in 14–15 and 15–16, which denotes the standard relative variance changed lower in recent years. Therefore, standard level of all students changed higher during current training objective.

However, since the improved teaching approach is only lasted for two years, there are also many problems in the approach. For example, dr and ds are not steady in these years, which denotes that the examination method needs to be improved. The index dn is lower, which denotes that the examination can not differentiate the ability of students well. All these problems will be researched in future.

5 Conclusion

In this paper, we discuss the difference between traditional and current training approach in course “applied mathematics” of postgraduate education. Postgraduates in college of computer, Inner Mongolia University is applied as the example to research this difference and study structure of a novel teaching approach to adapt current social requirement. Then, the improved teaching approach is experimented and analyzed by compared difference between the postgraduates which have been taught with the improved and traditional teaching approach. Experimental result shows the effectiveness of this improved teaching approach.

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