A Study of Engineering Doctoral Students' Research Experience and Degrees of Satisfaction in China

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Abstract. Engineering and technical talents are the key factors in the development of algorithms and computer technology. Engineering doctoral students (EDS), being engineering and technical talents to be, play a significant role in the sustainable development of information technology society. This study explored 163 EDS from a research university in Liaoning as the research object using SPSS to analyze whose research experience and degree of satisfaction about doctoral education. The results showed that EDS had participated in 2.02 research projects on average and generally had a high degree of satisfaction about their research training but a relatively low degree of satisfaction about support from organization and subsidies from supervisors. The research experience had a significant positive impact on enhancing EDS' research competency. The study provided a scientific basis for the cultivation of high-level innovative engineering and technical talents in algorithms and computer technology.

Keywords: algorithms and computer technology · engineering doctoral students · research experience · degree of satisfaction · SPSS

1 Introduction

The progress of algorithms and computer technology is closely related to the development of higher education [1]. As the highest level of higher education, the education of doctoral shoulders the heavy responsibility of cultivating high-quality and high-level creative talents for the country's modernization construction [2, 3].Engineering doctoral students(EDS) are the main and reserve force of research activities in the fields of natural science and computer technology in China [4]. The training quality of EDS directly reflects the level of technology and innovation ability, and is an important channel for building a powerful country in science and technology [5]. In view of the rapid development of engineering doctoral education and the continuous expansion of training scale, the quality has attracted the attention of the government and universities.

Unlike doctoral students in liberal arts and science, the cultivation of EDS has its own characteristics, EDS are faced with various practical problems such as science or engineering technology. The research of EDS is to sublimate these practical problems to

the theoretical level, abstract new scientific problems, establish appropriate models and describe these problems, and then put forward new algorithms, ideas and thoughts. It can be said that research activities run through the training of EDS, and the participation of EDS in research activities is the key to improve the training quality of EDS. At present EDS are expected to achieve a certain result, and in order to attain it, research experience and degrees of satisfaction are needed to be known, and how to understand the current situation of all aspects of EDS' participation in research activities in China, the best way is to survey and ask EDS about their research experiences and feelings, especially the satisfaction of EDS with research activities, which to some extent directly reflects the quality and problems of EDS.

2   Method

2.1   Preparation for Questionnaire

The questionnaire consists of 20 questions, including personal information, overall satisfaction of EDS' research training, research projects and academic evaluation, support from supervisors and organizations, promotion of research experience. The questionnaires were designed by the project team using the Likert five-level scale, the α coefficients of Cronbach were 0.905. Due to the high consistency index, this measurement meets requirements.

Based on the existing literature and used scales, the questionnaire has good content validity after pre-investigation of small samples.

2.2   Sources of Data

The sample used in this study involved 163 EDS in a research university of Liaoning. The details are shown in Table 1. The data comes from the author's own collation according to the survey.

3   Results

3.1   Overall Satisfaction of EDS' Research Training

On the whole, 28.5% of EDS expressed "great satisfaction" with the research training they received, 42.5% of EDS expressed "relatively satisfied", and a total of 71% of EDS were satisfied. The rate of "general" was 19.5%, "not very satisfied" was 6.5%, and "very dissatisfied" was 3%. The degree of satisfaction of EDS with various characteristics is obviously different, as shown in Table 2, male were higher than female, EDS with the bachelor degree from 985 universities were higher than 211 universities, and 211 universities were are higher than non-211 universities, EDS with the master degree from 211 universities were higher than 985 universities, and non-211 universities were are higher than 211 universities, EDS with non- Interdisciplinary were higher than that with the Master- Ph.D., the Master- Ph.D. were higher than the Bachelor-Master, the Bachelor-Master were higher than the All, EDS with worked experience were higher than non-experience, but the difference was not obvious. The admission type of Master-Ph.D. in EDS were higher than the General, and the General were higher than the Nonstop.

Table 1. Sample details

Personal information		N	Proportion (%)
Gender	Male	126	77.30
	Female	37	22.70
Age	20–30	127	77.91
	31–40	34	20.86
	Over 40	2	1.23
Bachelor	985	87	53.37
	211	54	33.13
	Non-211	22	13.50
Master	985	133	81.60
	211	29	17.79
	Non-211	1	0.61
Interdisciplinary	All	4	2.45
	Bachelor-Master	39	23.93
	Master- Ph.D.	4	2.45
	None	116	71.17
Worked	Yes	24	14.72
	No	139	85.28
Admission type	General	59	36.20
	Master-Ph.D.	80	49.08
	Nonstop	24	14.72

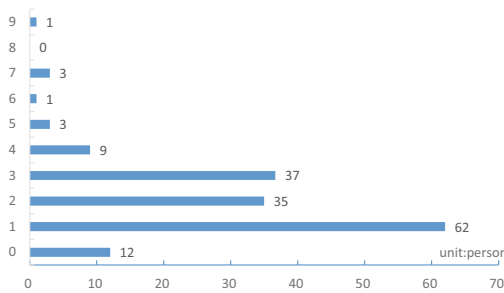## 3.2   Projects of Participation and Academic Evaluation

The majority of EDS were participating members of the research projects, and only a few are sub-project leaders. The EDS had participated in 2.02 research projects on average, as shown in Fig. 1, the largest number of EDS participated in one project was 62.

According to the academic evaluation of EDS on content of their research projects, only 7.6% expressed the academic evaluation of the research projects was "very high", 38.2% expressed the academic evaluation of the research projects was "high", 40.3% expressed that was "general", 10.5% expressed that was "low" and 3.4% expressed that was "very low". As shown in Table 3, the academic evaluation of male EDS were higher than that of female EDS, EDS with the bachelor and master degree from 985 universities were higher than others, EDS with worked experience were lower than non-experience, the admission type of Nonstop in EDS were higher than others.

Table 2. Overall satisfaction of EDS in research training

		The degree of satisfaction		The degree of satisfaction
Gender	Male	78.3%	Female	56.6%
Bachelor	985	67.2%	211	61.6%
	Non-211	54.8%	-	-
Master	985	59.3%	211	61.8%
	Non-211	56.0%	-	-
Interdisciplinary	All	42.3%	Bachelor-Master	49.7%
	Master- Ph.D.	59.2%	None	65.9%
Worked	Yes	73.5%	No	72.8%
Admission type	General	63.9%	Master-Ph.D.	76.5%
	Nonstop	56.1%	-	-

Note: The above data indicated the proportion of "great satisfactory" and "relatively satisfactory"

Fig. 1. Projects of participation

3.3   Supervisor's Subsidy and Organization's Research Support

The guidance of supervisors is the key factor affecting the development of EDS. EDS are improved in research level, academic ability and personal accomplishment in the process of supervisors' guidance, which has an important impact on EDS' satisfaction. Experimental instruments and equipment, books, funding to participate in academic exchanges were conducted by the research support from organizations. The subsidies from supervisors and the research support from organizations are essential means to promote the cultivation quality of EDS, the survey data supported this point, supervisors' subsidy($0.113.sig = 0$) and organization's research support($0.105.sig = 0$) were the two variables with the strongest partial correlation with the overall satisfaction of research experience.

According to the survey, for supervisors' subsidy, 9.6% of EDS were "great satisfied", 34.5% were "relatively satisfied", 36.7% were "general", 13.2% were "not satisfied" and 6% are "very dissatisfied". A total of 44.1% of EDS were satisfied with supervisors'

Table 3. Academic evaluation of research

		The degree of satisfaction		The degree of satisfaction
Gender	Male	42.6%	Female	38.4%
Bachelor	985	46.4%	211	41.3%
	Non-211	39%	-	-
Master	985	47.8%	211	37.6%
	Non-211	33.3%	-	
Interdisciplinary	All	40.1%	Bachelor-Master	35.1%
	Master- Ph.D.	34.5%	None	46.3%
Worked	Yes	44.2%	No	45.6%
Admission type	General	56.3%	Master-Ph.D.	51.2%
	Nonstop	62%	-	-

Note: The above data indicated the proportion of "very high" and "high"

subsidy. For organization's research support, the data was 8.4%, 36.9%, 38.2%, 11.4% and 5.1%, and a total of 45.3% of EDS were satisfied with the organization's research support. As is shown in Table 4, the various characteristics of EDS had the generally same situation in "supervisors' subsidy", male were higher than female, EDS with the bachelor and master degree from 985 universities were higher than others, EDS with worked experience were higher than non-experience, the admission type of General in EDS were higher than others.

Table 4. Supervisors' subsidy

		The degree of satisfaction		The degree of satisfaction
Gender	Male	40.1%	Female	39.5%
Bachelor	985	40.3%	211	39.4%
	Non-211	38.5%	-	-
Master	985	45.4%	211	43.6%
	Non-211	42.0%	-	
Interdisciplinary	All	42.1%	Bachelor-Master	43.5%
	Master- Ph.D.	42.7%	None	49.6%
Worked	Yes	38.5%	No	36.4%
Admission type	General	41.9%	Master-Ph.D.	38.0%
	Nonstop	35.4%	-	-

Note: The above data indicated the proportion of "great satisfactory" and "relatively satisfactory"

3.4 Promotion of All Aspects in Research Competency

This study explored the feelings of EDS on the promotion of innovation, academic, practical, learning and employment through participating in research. According to whether or not to participate in research projects, all the EDS were divided into two categories, and the differences between them were compared. EDS who had research experience in projects feeling that the proportion of "great" and "relatively" promotion in five aspects was about 23% higher than that of those who did not participate in the research projects.

4 Conclusion

The overall satisfaction of EDS' research training in China, with 2.02 research projects on average and 45.8%, 44.1% and 45.3% satisfaction with the academic evaluation, supervisors' subsidy and organizations' research support of the projects respectively, was acceptable that achieved a high level of 71%. Although EDS generally recognized the academic evaluation, as long as those participated in research projects, innovation and practice was improved by about 22%. The satisfaction of male in all aspects was higher than female. Under the environment of improving the quality of doctoral education in China, satisfaction is an effective index to reflect the subjective feelings of EDS on the quality of doctoral education.

5 Discussion

Engineering doctoral education shoulders heavy responsibility for cultivating, which should be strengthened today. According to this study, it is essential to take personalized EDS' training policy. Artificial intelligence technology based on big data can scientifically identify the personalization of EDS, by constructing EDS' training system based on blockchain technology, which is used to collect all kinds of data generated by EDS during their studies, on this basis, artificial intelligence technology is used to intelligently analyze the collected blockchain data of EDS, and three specific application directions based on artificial intelligence, such as clustering recommendation, personalized learning recommendation and research performance early warning, are put forward, so as to realize personalized intelligent management of EDS' training.

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