

Analysis of the Reality of the Undergraduate Research Assistant Program in Engineering College

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공학계열내 학부연구생 프로그램의 실태 분석

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ABSTRACT

This study proposes a means of guiding undergraduate research assistants programs in a more positive direction. This will be achieved by researching the reality of the programs operated in engineering departments for graduate school students and by analyzing the problems thereof. To achieve this objective, a literature study and research were conducted, which comprised of a survey on 204 graduate school students within the metropolitan area of Korea. The results of the study demonstrated that experience as an undergraduate research assistant has a positive influence on the adaptation to and life in graduate school. However, the role of the student and the level of salary varied depending on the role of the student, based on the capacity and support of individual professors. Thus, it is deemed that there will be a need for systematic program improvement and the development of a program that can provide significant academic activities, rather than simple experimental assistance.

Keywords: undergraduate research assistants, engineering education, survey research

1. Introduction

The career of graduates of engineering departments can be categorized into employment, enterprise, and entering graduate school. Due to the continually decreasing youth employment rate, the employment rate in the engineering industry field is also decreasing, whereas the entering into higher education is increasing [1]. However, university students are still experiencing a serious conflict with respect to their career path, and upon surveying 204 graduate school graduates who advanced into graduate school rather than preparing for employment, it was concluded that 60.1% of the respondents regret having advanced into graduate school because of low annual salary, recruit problem, curriculum of graduate school, etc [2].

Recently, various extra-curricular activities are operated in addition to curricular activities in order to enhance the

students' capacities in universities, wherein the undergraduate research assistants program is frequently operated for those hoping to advance into graduate school. Therefore, the undergraduate research assistants programs enforced in engineering departments can provide opportunities for the effective exploration of career paths for universities who have the goal of advancing into graduate school. They also provide the opportunity for undergraduate students to conduct research during their time at university. Through which, the students are able to familiarize themselves with the methods and properties of research, and to intensively understand academia, to ultimately nurture engineers with R&D skills, as well as expand the remarkable labor force in graduate schools. Furthermore, professors are able to obtain notable research human resources in advance [3].

However, rather than the program being operated as an official program run by the university, individual professors frequently operate this program based on their individual methods, and thus, the program is operated in various forms and methods. In many cases, There are wide variation in

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supporting range of work environment and salary [4]. That is, undergraduate students who participate in the undergraduate research assistants programs are used for simple tasks - in order to resolve the lack of labor force in laboratories, in some cases. Thus, it has now reached a point where the active support and cooperation of the instructing professors and graduate school students are needed, in addition to the university's interest and institutional support for the undergraduate research assistants program.

In foreign countries, the undergraduate research assistants program is operated in globally renowned universities, such as Stanford, Oxford, Harvard, and Cambridge. A systematic research program conducted on undergraduate students in the USA was initiated by M.I.T. in 1969, and soon thereafter, similar programs were established [5]. This undergraduate research assistants program was investigated to assist the undergraduate students in determining whether or not to advance into graduate school [5], and to increase satisfaction and cognitive skills towards education in their major [6].

As so, the undergraduate research assistants program has many advantages, and thus, it is a suitable time to apprehend the reality of the undergraduate students program in engineering departments, which is gradually expanding in Korea, and to propose its improvement direction.

This study has the objective of apprehending the reality of the undergraduate research assistants program by researching graduate school students who experienced the program in order to active the program and to prepare a means of improving thereof.

II. Method of the Study

To achieve the objective of this study, literature on the domestic and foreign undergraduate research assistants programs was reviewed. Furthermore, 204 graduate school students of the engineering department in ○○ University located in the metropolitan area of Seoul were surveyed.

The surveyed students were comprised of 170 male students (83.3%) and 34 female students (16.7%), with 181 students in their master's course (88.7%) and 23 students in their doctorate course (11.3%). Furthermore, with respect

to experience in the undergraduate research assistants program, 84 students (41.2%) had experience as undergraduate research assistants, and 120 students (58.8%) did not.

The distribution of gender in students with respect to experience in the undergraduate research assistants program displayed 71 male students (41.8%) who had had experience and 99 male students (58.2%) who had not; with 13 female students (38.2%) who had experience and 21 female students (61.8%) without. Thus, male students had a slightly higher ratio of experience in the undergraduate research assistants program than female students.

With respect to the type of course, 74 master's degree students (40.9%) had experience in the program and 107 master's course students (59.1%) did not; 10 doctorate degree students (43.5%) had experience in the program and 13 doctorate course students (56.5%) did not. Thus, graduate school students in their doctorate course had a higher ratio of experience in the undergraduate research assistants program than students in their master's course.

In the survey, the students' satisfaction and adaptability in graduate school, and experience in the undergraduate research assistants program were examined. Furthermore, graduate school students with experience in the undergraduate research assistants program were surveyed as set forth below in <Table 1> in order to apprehend the reality of the undergraduate research assistants program.

Table 1 Survey Content

category	researched content
general individual backgrounds and satisfaction in graduate school	<ul style="list-style-type: none"> ▪ gender, type of course, major ▪ experience in the undergraduate research assistants program ▪ satisfaction in major, daily life, operating method, and task execution in graduate laboratory
undergraduate research assistants	<ul style="list-style-type: none"> ▪ salary, difficulty, role, type and degree of guidance ▪ number of taking courses and credits in graduate school ▪ participating time, route of participation, reason for participation, content and degree of assistance ▪ recommendation of undergraduate research assistants program ▪ problems and improvements of the undergraduate research assistants program

III. Results

1. Route and Reason for Participation

With regards the route of entering the undergraduate research assistants program, the majority of students (59 students, 70.2%) voluntarily entered the program, followed by 13 students (15.5%) who were recommended by colleagues or seniors, 8 students (9.5%) who were recommended by the academic advisors, and 4 students (4.8%) who were decided by other ways. There were no significant differences in terms of gender and type of degree.

Meanwhile, concerning the reasons for selecting the undergraduate research assistants program, 48 students (57.1%) responded 'because I had decided to enter into graduate school', followed by 'to experience about graduate school life' (15 students, 17.9%), 'to explore my field of major' (10 students, 11.9%), and 'to gain another joy in undergraduate life' (7 students, 8.3%). But 4 students (4.8%) selected the program with another reasons.

Female students responded only to two reasons: 'because I had decided to enter into graduate school' and 'to find out about graduate school life'. However, male

students participated in the undergraduate research assistants program for more diverse reasons, such as 10 students (14.1%) who responded to exploring their field of major and 7 students (9.9%) who responded to gain another joy in undergraduate life.

2. Activity of Undergraduate Research Assistants

Upon analysis of the overlapping responses with respect to the main role as undergraduate research assistants, the majority of students, 59 students (70.2%) responded 'experiment assistance', followed by 14 students (16.7%) with 'data arrangement', and 9 students (10.7%) with 'others'. Responses in 'others' included 'study in a field of interest', 'dissertation search', 'acquiring knowledge in relation to graduate school', and 'unimportant work'. There was no significant difference in terms of gender or type of degree.

Upon examining the number of taking courses in graduate school as undergraduate research assistants, 43 students (51.2%) responded 'none', 23 students (27.4%) responded '1 course', 17 students (20.2%) responded '2 courses' and 1 student (1.2%) responded '3 courses'. Thus, it was

Table 2 Reason for Selecting the Undergraduate Research Assistants Program

category	gender		type of degree	
	male	female	master's	doctorate
financial Support	1(1.4)	-	1(1.4)	-
exploration of field of major	10(14.1)	-	9(12.2)	1(10.0)
gain joy in undergraduate life	7 (9.9)	-	7(9.5)	-
decision to advance into graduate school	38(53.5)	10(76.9)	41(55.4)	7(70.0)
information of graduate school life	13(18.3)	2(15.4)	13(17.6)	2(20.0)
spatial support for study	2(2.8)	-	2(2.7)	-
no response	-	1(7.7)	1(1.4)	-
total	71(100.0)	13(100.0)	74(100.0)	10(100.0)

Table 3 Role of Undergraduate Research Assistants

category		data arrangements	experiment assistance	assistance with preparation of dissertation	administrative affairs for research	others	total
gender	male	12(16.9)	50(70.4)	5(7.0)	1(1.4)	9(12.7)	71(84.5)
	female	2(15.4)	9(69.2)	-	3(23.1)	-	13(15.5)
type of degree	master's	13(17.6)	50(67.6)	5(6.8)	4(5.4)	9(12.2)	74(88.1)
	doctorate	1(10.0)	9(90.0)	-	-	-	10(11.9)

Table 4 Salary of Undergraduate Research Assistants

category		no salary	less than 100,000 won	100,000 to 200,000 won	200,000 to 300,000 won	more than 300,000 won	total
gender	male	24(33.8)	16(22.5)	12(16.9)	14(19.7)	5(7.0)	71(100.0)
	female	5(38.5)	3(23.1)	3(23.1)	1(7.7)	1(7.7)	13(100.0)
type of degree	master's	27(36.5)	16(21.6)	13(17.6)	14(18.9)	4(5.4)	74(100.0)
	doctorate	2(20.0)	3(30.0)	2(20.0)	1(10.0)	2(20.0)	10(100.0)

Table 5 Method of Guidance by Professors to the Undergraduate Research Assistants

category		Regular 1:1 meetings	regular group meetings	irregular 1:1 meetings	irregular group meetings	total
gender	male	7(9.3)	20(26.7)	34(45.3)	14(18.7)	75(100.0)
	female	3(20.0)	5(33.3)	4(26.7)	3(20.0)	15(100.0)
type of degree	master's	10(12.8)	20(25.6)	32(41.0)	16(20.5)	78(100.0)
	doctorate	-	5(41.7)	6(50.0)	1(8.3)	12(100.0)

Note: These results are based on multiple replies by the respondents

displayed that more than half of the responders did not take any graduate school courses, and even if courses had been taken, only 1 or 2 were taken. Furthermore, the average number of taking courses was 0.7 – less than 1.

Upon examining the ratio of students who had completed more than 1 subject, 36 of the respondents (50.7%) were male students, which was higher than 5 female students (38.5%). 7 of the respondents (70.0%) were in their doctorate course and 34 respondents (45.9%) in their master's course.

Furthermore, with respect to the average time consumed in performing the role as undergraduate research assistant per week, 27 students (32.1%) spent more than 20 hours, 19 students (22.6%) spent 5 to 10 hours, 16 students (19.0%) spent 10 to 15 hours and 15 to 20 hours, individually, but 6 students (7.1%) spent less than 5 hours. Thus, the ratio of students who performed their role as undergraduate research assistant for over 10 hours a week was 70.1% (59 students).

Meanwhile, some of the undergraduate research assistants received a salary for certain aspects of their role and time, which was researched as follows. That is, with respect to the salary of undergraduate research assistants, 29 students (34.5%) received no salary, while 19 students (22.6%) received less than 100,000 won. There were no significant differences in terms of gender or type of degree

in this regard.

Upon questioning the students as to whether they received the guidance from the professor during the undergraduate research assistants program, 41 students (48.8%) replied 'good guidances were received', 17 students (20.2%) replied 'great guidances were received', and thus, 69.0% of all respondents replied that they receive guidances. There were no students who were unsatisfied with the degree of guidances, and there was no significant difference in terms of gender or type of degree.

Upon analysis of the overlapping responses with respect to the method of guidances given by the professor during the undergraduate research assistants program, 38 students (42.2%) replied 'irregular one-on-one meetings', 25 students (27.8%) replied 'regular group meetings', 17 students (18.9%) replied 'irregular group meetings' and 10 students (11.0%) replied 'regular one-on-one meeting'. Thus, it was indicated that guidances were mostly provided through irregular one-on-one meetings and regular group meetings. There was also a method of using two or more types of giving guidances.

Meanwhile, with respect to the difficulty in simultaneously conducting the undergraduate and graduate school, 39 students (46.4%) responded 'bearable', 24 students (28.6%) responded 'not difficult (including never difficult)', and 21 students (25.0%) responded that 'it was difficult (including

Table 6 Degree of difficulty for the Undergraduate Research Assistants

category		never difficulty	not difficulty	bearable	difficulty	very difficulty	total
gender	male	3(4.2)	16(25.4)	32(45.1)	14(19.7)	4(5.6)	71(100.0)
	female	-	3(23.1)	7(53.8)	2(15.4)	1(7.7)	13(100.0)
type of degree	master's	3(4.1)	16(21.6)	35(47.3)	16(21.6)	4(5.4)	74(100.0)
	doctorate	-	5(50.0)	4(40.0)	-	1(10.0)	10(100.0)

Table 7 Satisfaction in Graduate School

category	cases	average	standard deviation
major	203	3.97	0.69
life	203	3.66	0.76
operating method	203	3.40	0.80
research execution	203	3.74	0.83

Note: Index(1=not satisfied at all, 2=not satisfied, 3=slightly satisfied, 4=satisfied, 5=very satisfied)

very difficult)'. Thus, the result found students who simultaneously performing the program alongside their studies are bearable.

In particular, there was no significant difference in terms of gender, and the ratio of graduate students who felt that the undergraduate research assistants program (difficult or very difficult) displayed 20 students in their master's course (27.0%) and 1 student in their doctorate course (10.0%). The graduate school students in their master's course felt greater difficulty in the undergraduate research assistants program than students in their doctorate course.

3. Satisfaction

The students were questioned on their satisfaction in

graduate school in terms of major, daily life, operating method and research execution. Satisfaction in all four sections received over 3.40 (out of 5) points, and thus, it was concluded that the students were generally happy with their graduate school life.

Furthermore, satisfaction in major was the highest at 3.97, followed by satisfaction in relation to research execution at 3.74, and satisfaction in life at 3.66, whereas the satisfaction of the operating method was 3.40 - which is lower than the other categories of satisfaction.

The results of the analysis of the differences between satisfaction based on the experience in an undergraduate research assistants program are as shown in <Table 8> below.

Furthermore, upon examining how much the undergraduate

Table 8 Degree of Satisfaction at the Graduate School based on the Experience in the Undergraduate Research Assistants Program

category		cases	average	standard deviation	t-value
major	yes	84	4.05	0.74	1.515
	no	119	3.91	0.64	
daily life	yes	84	3.79	0.82	1.935
	no	119	3.57	0.71	
operating method	yes	84	3.36	0.86	-0.685
	no	119	3.44	0.76	
research execution	yes	84	3.89	0.87	2.139*
	no	119	3.64	0.79	

Note: 1) Index(1= not satisfied at all, 2=not satisfied, 3=slightly satisfied, 4=satisfied, 5=very satisfied)

2) * $p < .05$, ** $p < 0.01$

Table 9 Helps of the Undergraduate Research Assistants Program on Graduate School Life

category		general understanding of the research process	effective communication between laboratory members	effective communication with the professor	intensive research and understanding of a professional field	regular time in the laboratory	total
gender	male	34(37.4)	29(31.9)	4(4.4)	16(17.6)	8(8.8)	91(100.0)
	female	5(33.3)	5(33.3)	-	1(6.7)	4(26.7)	15(100.0)
type of degree	master's	34(37.0)	32(34.8)	3(3.3)	13(14.1)	10(10.9)	92(100.0)
	doctorate	5(35.7)	2(14.3)	1(7.1)	4(28.6)	2(14.3)	14(100.0)

Note: This result is based on multiple replies by the respondents

research assistants program has helped in graduate school life, 49 students (58.3%) replied 'it helped', 25 students (29.8%) replied 'it helped very much'. 74 students (88.1%) replied that the program helped ('helped' or 'helped very much'). Thus, it was concluded that most students think that the undergraduate research assistants program helps in graduate school life, and there were no significant differences in terms of gender or type of degree.

More specifically, upon questioning whether the undergraduate research assistants program directly or indirectly helped in graduate school life, 39 students (36.8%) replied 'general understanding of the research process', 34 students (32.1%) replied 'effective communication between the laboratory members' and 17 students (16.0%) replied 'intensive research and understanding of a professional field'.

Meanwhile, upon questioning the students as to whether the undergraduate research assistants program would be recommended to juniors or friends, 77 students (91.7%) responded 'I would recommend it', and thus, it was concluded that the program has a relatively positive effect.

4. Problems and Proposals

The most difficult aspect of simultaneously participating in undergraduate and graduate school courses was that of 'difficulty in time management'. Particularly, the responses included undergraduate classes and examinations and graduate school projects (experiments), a lack of time due to concomitant conduction of seminars, and a lack of personal time. Furthermore, there were other difficulties including the adaptation of the relationship with graduate

school seniors, financial difficulties, the burden of undergraduate research assistant work, falling off physical strength due to excessive graduate school work, and a lack of academic background knowledge.

The problems of the undergraduate research assistants program included relationships with peers, and a lack of personal time for self-development (English, computer skills, licenses etc.). This was followed by the conflict of undergraduate work and graduate school work, the adaptation to the laboratory and relationships with seniors, as well as external factors of the laboratory. In addition, there were policy problems of insufficient salary and orientation program, as well as the allocation of undergraduate research assistants per laboratory without regard to the interests of the students.

The demands for the university's support and policy on the undergraduate research assistants program are as set forth below.

First, there is a need for specific promotional activity of the undergraduate research assistants program. Because the undergraduate research assistants program is performed for each major (laboratory), it is difficult to approach information on other majors, and thus, there is a need for a system wherein the laboratory suitable for individual aptitudes can be selected, and an expansion of an experiential system (open laboratory) for each laboratory. Furthermore, there is a need for the orientation of pre-enrolment courses in graduate school, method of operating experiment equipment, and safety education.

Second, there is a need for the preparation of an economic support means for the undergraduate research assistants program. In order for undergraduate research assistants to

feel a sense of belonging and responsibility, there will be a need to provide similar benefits to graduate school students, and to provide economic support through various scholarships.

Third, a means of relieving the burden of time of the undergraduate research assistants should be explored. There is a need to adjust the schedule so that it does not overlap with undergraduate classes and tests. There is also a need to expand the scope of recognition of major credits of subjects that have been enrolled in advance.

Fourth, systematization of the position, role, and treatment of undergraduate research assistants is required. Currently, the salary, role, and participating time of the undergraduate research assistants are dependent on the discretion of the professor in each laboratory. Thus, there is a need to systematize a rational operation of these elements.

IV. Conclusion

The undergraduate research assistants program is a program where undergraduate students who wish to advance into graduate school can familiarize themselves and learn the research processes at the laboratory together with professors and graduate school students in advance, which is variously used in each major. This undergraduate research assistants program has the advantage of allowing undergraduate students to approach programs and equipment by participating in graduate school experiments and projects, and provides the opportunity of contacting researchers and graduate school students of the laboratory, whereas there are difficulties in performing the role as undergraduate research assistants due to a lack of time based on the simultaneous participation of undergraduate and graduate school courses, simple tasks, and low salary. Accordingly, this study has conducted a survey on 204 students in order to examine the reality of undergraduate research assistants, and the effects of the experience in the program on the satisfaction of graduate school and the level of exploration of career paths.

First, the majority of the 204 respondents were male

students in their master's courses. Upon examining the satisfaction in graduate school of the respondents with experience in the undergraduate research assistants program, the respondents displayed a generally reasonable satisfaction rate, and the highest satisfaction in their major, whereas, their satisfaction in the method of operation of the program was relatively low, and was displayed to require improvement.

With respect to the satisfaction of the research execution in graduate school, the students with experience in the undergraduate research assistants program had a relatively higher satisfaction of 3.89 in comparison to the students without experience in the undergraduate research assistants program. Thus, it can be concluded that the students participating in the undergraduate research assistants program can rapidly adapt to the processes in graduate school and had higher satisfaction therein. This is because they have already obtained a certain level of knowledge regarding the procedures of performing research tasks.

Upon examining the results of the undergraduate research assistants program, most of the undergraduate students who have decided to advance into graduate school voluntarily apply for the program. The respondents have demonstrated that the advantages of the undergraduate research assistants program include increased understanding of the research process and field of major, and effective communication with the members of the laboratory, and most of the respondents replied that they would recommend the undergraduate research assistants program to juniors or friends.

However, degree of salary was low for their working time in terms of the minimum incomes standard, and there were no set standards for either the working time or salary; instead, they were rather diversely determined by the professor. They also experienced great difficulty in time management concerning the simultaneous participation in undergraduate and graduate school courses.

Accordingly, it was demonstrated that there is a need for positive support by the university for the undergraduate research assistants program, and that there is a need for

the program to provide opportunities for pre-graduate school students to gain access to various knowledge and technologies, rather than merely performing experiment assisting roles. Furthermore, it was displayed that there is also a need for the professors to take interest and manage the program.

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