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How Should Graduate School Education at Research University be Reformed: Findings from the NRC Graduate Student Survey 2006

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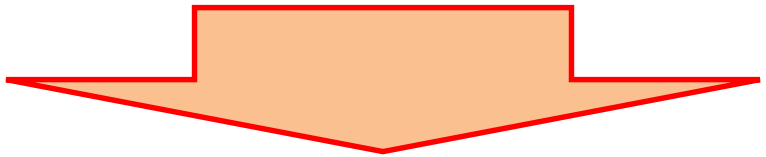
I. INTRODUCTION

1. Purpose

- From the perspective of higher education research contribute to higher education reform



On the **graduate school education**
at the engineering fields, **to propose with evidence the factors that improve research productivity**.

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2. Background

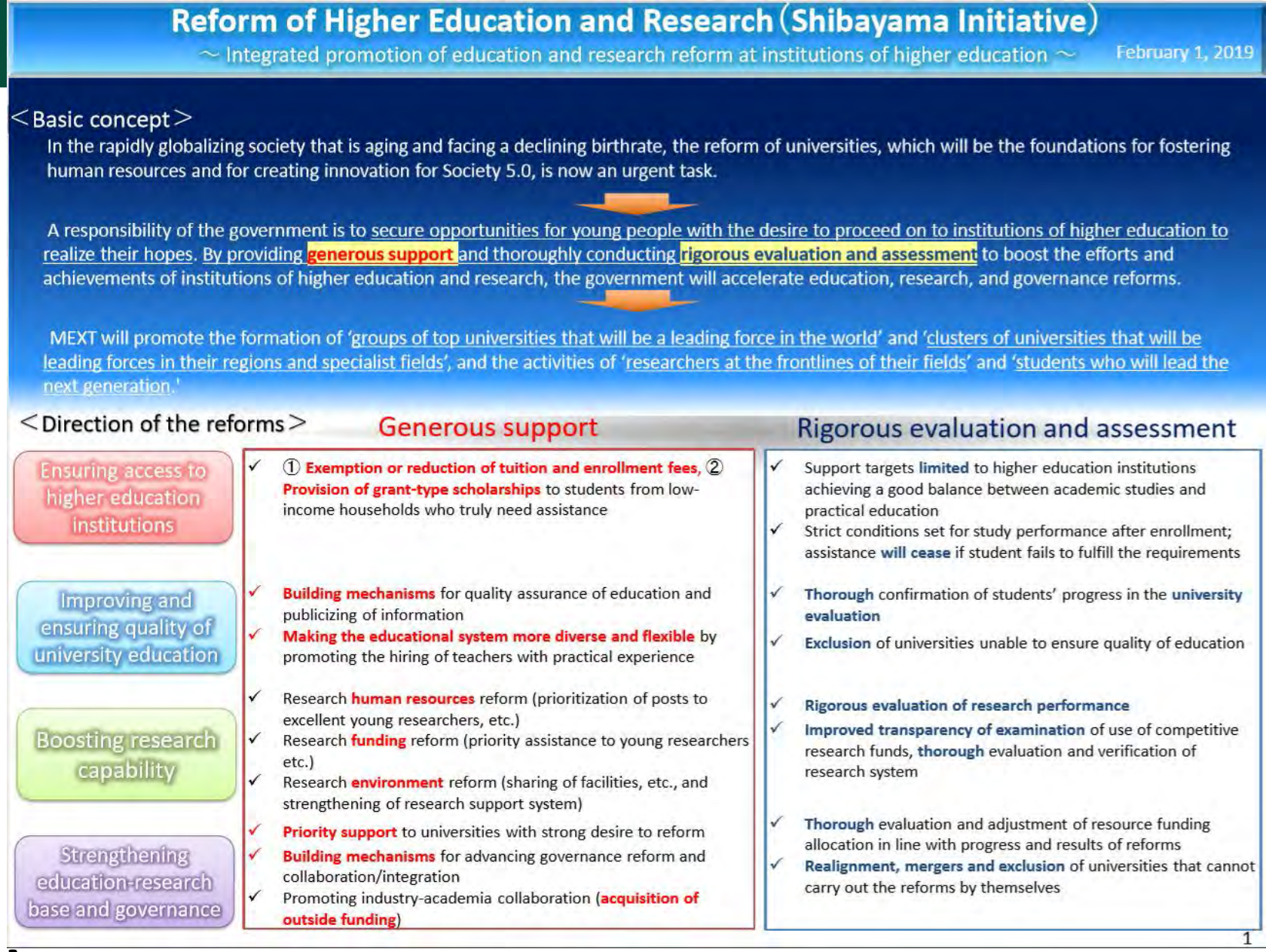
(1) MEXT initiative

Ministry of Education, Culture, Sports, Science and Technology,

(February 1, 2019)

Reform of Higher Education and Research

(Shibayama Initiative)



Reform of Higher Education and Research (Shibayama Initiative)

～ Integrated promotion of education and research reform at institutions of higher education ～ February 1, 2019

＜Basic concept＞

In the rapidly globalizing society that is aging and facing a declining birthrate, the reform of universities, which will be the foundations for fostering human resources and for creating innovation for Society 5.0, is now an urgent task.

A responsibility of the government is to secure opportunities for young people with the desire to proceed on to institutions of higher education to realize their hopes. By providing generous support and thoroughly conducting rigorous evaluation and assessment to boost the efforts and achievements of institutions of higher education and research, the government will accelerate education, research, and governance reforms.

MEXT will promote the formation of 'groups of top universities that will be a leading force in the world' and 'clusters of universities that will be leading forces in their regions and specialist fields', and the activities of 'researchers at the frontlines of their fields' and 'students who will lead the next generation.'

＜Direction of the reforms＞

	Generous support	Rigorous evaluation and assessment
Ensuring access to higher education institutions	✓ ① **Exemption or reduction of tuition and enrollment fees**, ② **Provision of grant-type scholarships** to students from low-income households who truly need assistance	✓ Support targets **limited** to higher education institutions achieving a good balance between academic studies and practical education ✓ Strict conditions set for study performance after enrollment; assistance **will cease** if student fails to fulfill the requirements
Improving and ensuring quality of university education	✓ **Building mechanisms** for quality assurance of education and publicizing of information ✓ **Making the educational system more diverse and flexible** by promoting the hiring of teachers with practical experience	✓ **Thorough** confirmation of students' progress in the **university evaluation** ✓ **Exclusion** of universities unable to ensure quality of education
Boosting research capability	✓ Research **human resources** reform (prioritization of posts to excellent young researchers, etc.) ✓ Research **funding** reform (priority assistance to young researchers etc.) ✓ Research **environment** reform (sharing of facilities, etc., and strengthening of research support system)	✓ **Rigorous evaluation of research performance** ✓ **Improved transparency of examination** of use of competitive research funds, **thorough** evaluation and verification of research system
Strengthening education-research base and governance	✓ **Priority support** to universities with strong desire to reform ✓ **Building mechanisms** for advancing governance reform and collaboration/integration ✓ Promoting industry-academia collaboration (**acquisition of outside funding**)	✓ **Thorough** evaluation and adjustment of resource funding allocation in line with progress and results of reforms ✓ **Realignment, mergers and exclusion** of universities that cannot carry out the reforms by themselves

1

http://www.mext.go.jp/component/a_menu/other/detail/__icsFiles/afieldfile/2019/08/20/1413322_03.pdf

Reform of Higher Education and Research （Shibayama Initiative） (February 1, 2019)

Four Directions:

1. **Ensuring access to higher education institutions**
2. **Improving and ensuring quality of university education**
3. **Boosting research capability**
4. **Strengthening education-research base and governance**

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2. Background

(2)Cabinet decision, (June 21, 2019)

Integrated Innovation Strategy 2019

① Social implementation of Society 5.0
② Strengthen **research capabilities**
③ Fundamental strengthen international collaboration
④ Build priority strategies in cutting-edge fields

https://www8.cao.go.jp/cstp/togo2019gaiyo.pdf

II. PREVIOUS STUDIES

- Tinto, V. (1975, 1993) has impacted large influence.
  e.g. gradSERU(SERU Graduate Student Survey: UCB et al) use his theory as their conceptual framework.
  (https://cshe.berkeley.edu/seru/about-seru/gradseru-survey-design)

Conceptual Framework

Grounded in the tenets of Tinto's (1993) "theory of graduate communities and doctoral persistence", the gradSERU Survey conceptualizes the graduate student experience as a three-stage process that encompasses the entry/transition stage, the development stage, and the degree completion/exit stage.

gradSERU Survey Design

III. Data and Framework

1. Data：Graduate Student Survey 2006

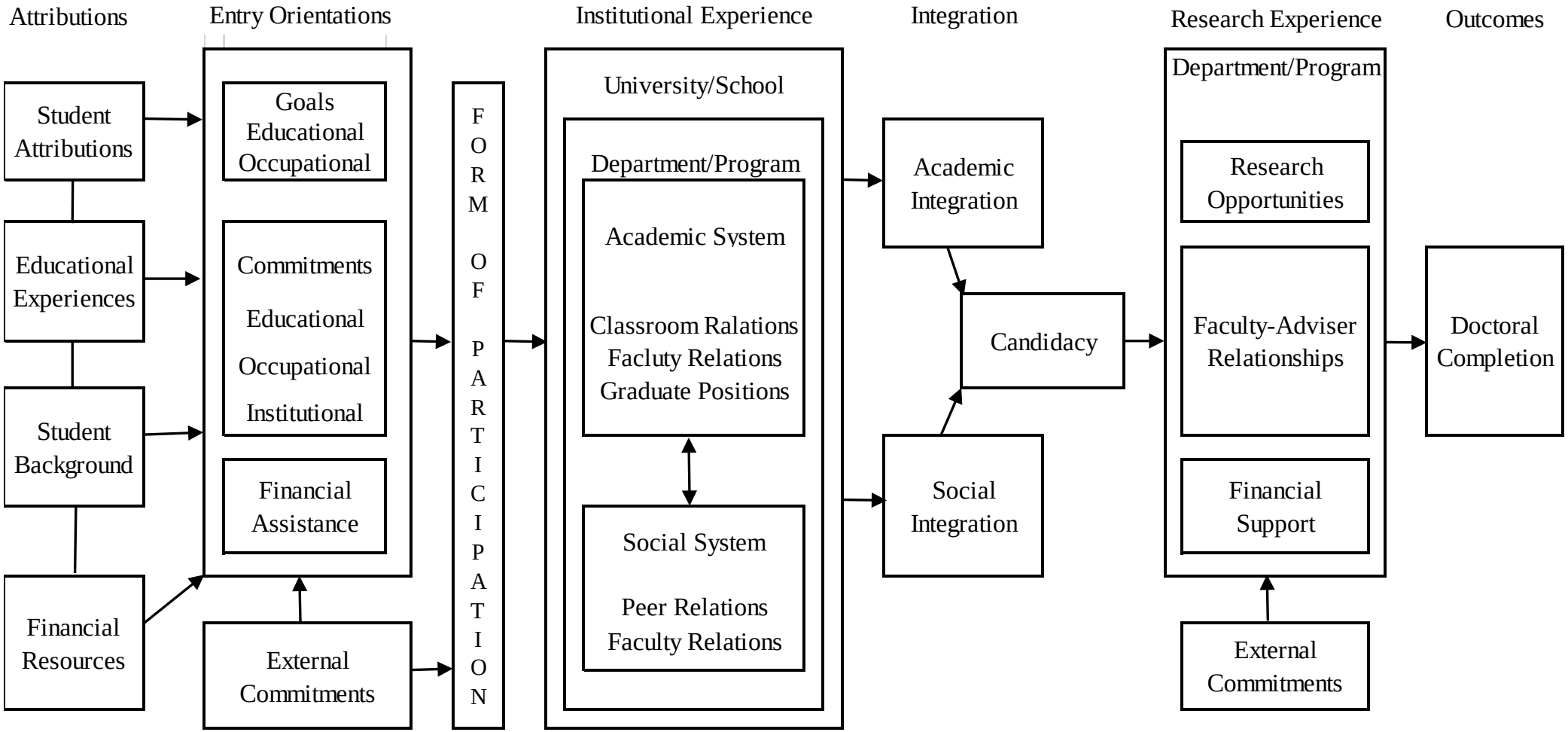
- Implementation：In 2006, by National Research Council (NRC)
- Respondents：Doctoral candidates in the US Research Universities
- Questionnaire survey（In the following, graduate student survey）
- NRC has assessed the doctoral programs of the research universities in 1982, 1995 and 2010.
- This survey was implemented as part of the 2010 assessment.
- See Ostriker et al. (2010) about details of the 2010 assessment. Overall response rate 70% (Table 7-14,p. 99).
- Used the data archive of the ICPSR: Inter-University Consortium for Political and Social Research. (https://www.icpsr.umich.edu/icpsrweb/)

Table Ⅲ-1 Respondents of Graduate Student Survey by Fields

	(n)	percentage	valid percentage	cumulative percentage
Biological and Health sciences	(1,579)	13.0	13.3	13.3
Physical and Mathematical sciences	(3,620)	29.8	30.5	81.8
Engineering	(1,850)	15.2	15.6	28.9
Social and Behavioral sciences	(2,166)	17.8	18.2	100.0
Humanities	(2,670)	22.0	22.5	51.3
Total	(11,885)	97.9	100.0	
Missing	(253)	2.1		
Total plus Missing	(12,138)	100.0		

Source: Author made from variables BROADFID of NRC Graduate Student Survey 2006.

2. Frame of Reference



Source: Tinto(1993),p.240.

Figure III-1 A longitudinal model of doctoral persistence
from the theory of graduate communities and doctoral persistence

- Three Stages of Graduate Education Process, Tinto (1993)

1）Entry/Transition stage

2）Development stage

3）**Degree completion/Exit stage** ➔ Research Experience

*"Graduate students acquire the status of **doctoral candidates** and successfully complete the **research project** and **defense of the dissertation**."*(p.237)

- From Tinto's theory, **factors anticipated improving research productivity** are as follows:

(a) Relationship with the Advisor and the Dissertation Committee

(b) Financial Support and

(c) External Commitment

*External commitment means responsibility for work and family.

- Combine Tinto‘s doctoral persistence model with Astin's theory of Student Involvement and I-E-O model.

To Astin’s (I)pre-entrance information-(E)environment-(O)outcomes,

- Tinto divided the (E) environment into three stages
  (1) Entry/Transition stage
  （Entry Orientations）
  (2) Development stage
  (Institutional Experience)
  (3) Degree completion/Exit stage
  (Research Experience)

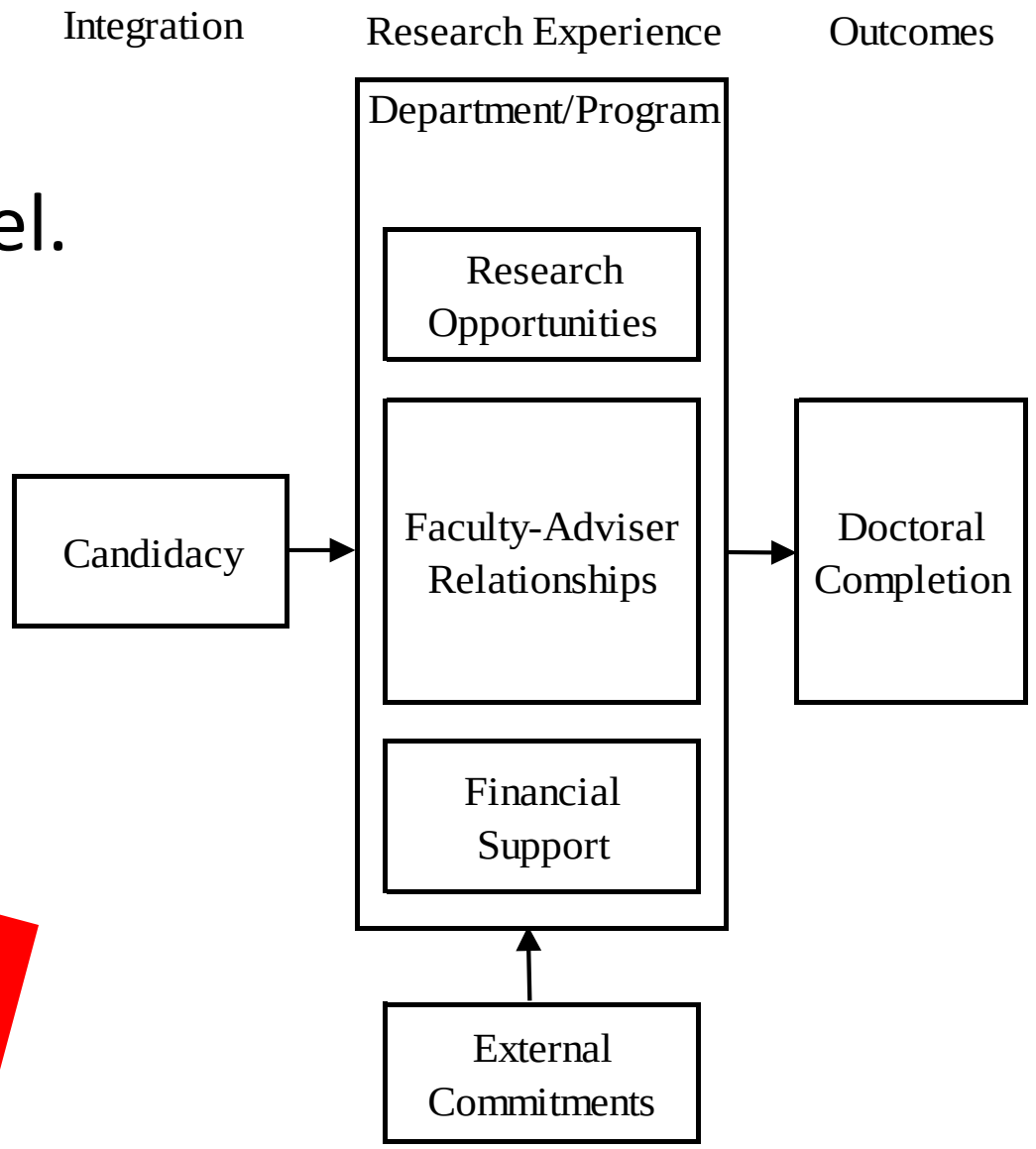


Figure III-2 A longitudinal model of doctoral persistence: 3rd Stage

- Examine Tinto‘s 3rd Stage (Research Experience) with Astin’s theory of Involvement and I-E-O model

(Ⅰ)Pre-entrance Information

Race/Ethnicity, Age, Gender, Educational Achievement of Father and Mother, **Dependents ←as External Commitment**

(E)Research Environment

Financial Support

Travel funds for research presentation at off-campus
Full support with fellowship, traineeship, or assistantship

Relationships with Faculty and Other Students, Sense of Belonging

(O)Research Outcomes

Research Presentation（On-campus, Off-campus: regional, national, international ）
Refereed Articles（Include Authored, Coauthored, Accepted for Publication）

IV. Descriptive Analysis

Table Ⅳ-1 Descriptive Statistics of Explanatory Variables

		All Fields		Engineering	
		M	SD	M	SD
Pre-enrollment Information					
Racial background[1)]	White(%)	**66.0**	0.47	48.0	0.50
	Asian(%)	31.0	0.47	**49.0**	0.50
Birth year		1976.2	5.49	1978.2	3.88
Gender	Female(%)	**39.0**	0.49	**30.0**	0.46
Highest educational attainment[2)]	Father	3.1	1.42	2.9	1.33
	Mother	2.6	1.32	2.5	1.23
Dependents[3)]	Yes(%)	**19.0**	0.39	**16.0**	0.36
Research Experiences					
Financial support	Travel funds(%)	**65.0**	0.48	**71.0**	0.45
	Full support[4)](%)	**78.0**	0.42	**83.0**	0.37
Relationship with faculty[5)]	Advisor	4.2	1.00	4.2	0.96
	In program	3.6	0.99	3.5	0.94
Relationship with students in program[6)]		3.9	1.01	4.0	0.94
Sense of belonging[7)]		2.4	0.64	2.6	0.58

1) Racial background is multiple answers.
2) Highest educational attainment is
1=Below high school,
2=Some college, 3=Bachelor's degree,
4=Master's degree,
5=Doctoral or Professional degree.
3)Depenents is 0=No denpendens, 1=Yes, I have.
4)Full support is 0=not cover full cost,
1=cover full cost with fellowship, scholarship, traineeship, or assistantship.
5) Relationship with faculty is five-point scale,
1=Distant, Antagonistic or Hostile, 3=Neutral,
5=Highly interactive, supportive.
6) Relationship with students in program is five-point scale, 1=Not supportive,
3=Somewhat supportive, 5=Very Supportive.
7) Sence of belonging is reverse three-point scale,
1=Not at all, 2=Some, 3=A lot.

Table Ⅳ-1: Descriptive Statistics of Explanatory Variables

- Pre-entrance Information
  1. Race/Ethnicity: All Fields Whites(66%), Engineering Asian(49%)
  2. Birth year（Average）: All Fields (1976, 30 yrs. old), Engineering (1978, 28 yrs. old)
  3. Gender（Female）: All Fields（39%）, Engineering（30%）
  4. Educational attainment（Average） Father is Bachelor's degree, Mothers is a little less than Fathers.
  5. Dependents（Yes） All Fields（19%）, Engineering（16%）
- Research Environment
  1. Financial support：Engineering Travel funds(71%), Full support(83%)
  2. Relation with Faculty：Advisor（Both 4.2）, In program(3.6～3.5)
  3. Relation with Students: All Fields（3.9）, Engineering(4.0)
  4. Sense of belonging(3 points scale): All Fields(2.4), Engineering(2.6)

Table Ⅳ-2, Table Ⅳ-3: Number of Research Presentation

Table Ⅳ-2 Number of Research Presentation on Campus: Five Category

	All Fields		Engineering	
	n	Valid Percent(%)	n	Valid Percent(%)
0	3,400	**29.0**	366	**20.4**
1	2,151	18.4	301	16.8
2	1,991	17.0	316	17.6
3	1,392	11.9	272	15.1
4 or more	2,774	23.7	542	**30.2**
Total[1)]	11,708	100.0	1,797	100.0

Table Ⅳ-3 Number of Research Presentation at Regional, National, or International Meetings: Five Category

	All Fields		Engineering	
	n	Valid Percent(%)	n	Valid Percent(%)
0	2,825	23.9	309	**17.0**
1	1,815	15.3	283	15.5
2	1,697	14.3	271	14.9
3	1,435	12.1	251	13.8
4 or more	4,063	**34.3**	709	**38.9**
Total[1)]	11,835	100.0	1,823	100.0

- On Campus(mode): All Fields 0 times (29%), Engineering 4 or more times (30%).
  However, 20% of Engineering is 0 times.
- Off Campus(mode): 4 or more times（All fields 34%, Engineering 39%）.
  However, 17% of Engineering is 0 times.

Table Ⅳ-4 : Number of Refereed Articles

Table Ⅳ-4 Number of Refereed Articles, Authored or Coauthored Including Accepted for Publication: Five Category

	All Fields		Engineering	
	n	Valid Percent(%)	n	Valid Percent(%)
0	5,162	**45.1**	511	**28.6**
1	2,222	19.4	354	19.8
2	1,442	12.6	299	16.7
3	913	8.0	195	10.9
4 or more	1,696	14.8	427	**23.9**
Total[1)]	11,435	100.0	1,786	100.0

- Num of Refereed Articles（mode）: 0 articles（All Fields 45%, Engineering 29%）. However, 24% of Engineering is 4 or more articles.

Ⅴ. Determinants Analysis

Table Ⅴ-1 Multiple Regreession in the Field of Engineering

			Research Presentation on Campus				Research Presentation at Regional, National, or International Meetings				Refereed Articles, Authored or Coauthored			
			B	SE	β		B	SE	β		B	SE	β	
Pre-entrance Information	Racial background	White dummy variable	-.064	.176	-.021		.258	.160	.084		.336	.175	.109	
		Asian dummy variable	-.237	.177	-.078		.181	.161	.059		.352	.175	**.114**	*
		Gender dummy variable	-.053	.080	-.016		.128	.073	.038		-.087	.079	-.026	
		Age five-points scale[1)]	.070	.055	.034		.372	.050	**.180**	***	.326	.054	**.156**	***
	Highest educational attainment	Father	.009	.034	.008		.039	.031	.034		.029	.034	.025	
		Mother	.001	.038	.001		.011	.035	.009		.013	.037	.010	
	Dependents dummy variable		.037	.111	.009		-.058	.101	-.014		.282	.110	**.066**	**
Research Experiences	Financial Support	Travel funds	.713	.081	**.213**	***	1.423	.074	**.419**	***	.760	.081	**.223**	***
		Full support	-.168	.102	-.040		.060	.093	.014		.060	.102	.014	
	Relationship with faculty	Advisor	.099	.043	**.063**	*	.051	.039	.032		.177	.043	**.111**	***
		In program	.034	.046	.021		-.017	.042	-.010		.012	.046	.007	
	Relationship with students in program		.003	.044	.002		-.015	.040	-.009		-.040	.044	-.024	
	Sence of belonging to program		.113	.074	.043		.085	.068	.032		.033	.073	.012	
Constant			1.96	0.34		***	0.87	0.31		**	0.36	0.33		
R^2			.066				.222				.108			
Adjusted R^2			.058				.216				.101			
No of observations			1,643				1,670				1,641			

Table Ⅴ-1：Multiple Regression in the Field of Engineering

- This model doesn't explain well.
  Because the coefficient of determination(R^2) is not good.
- Statistically significant explanatory variables

1. Race/Ethnicity（Asian）		Refereed Article
2. Age 5 points	Off-campus Presn.	Refereed Article
3. Dependents（Yes, I have）		Refereed Article
4. Travel funds	On/Off-campus Presn.	Refereed Article
5. Advisor faculty	On-campus Presn.	Refereed Article

Q1. Travel funds positively affects even on-campus presn. and articles.

Q2. Full support has no significant impact on research outcomes.

Q3. Dependents have a positive impact on refereed articles.

VI. Discussion and Conclusion

- What I analyzed that the research experience of doctoral students in the US research university focused with the engineering field.
- The data is graduate student survey 2006 by the National Research Council.
- The research framework is Tinto (1993) "A longitudinal model of doctoral persistence," Astin (1984, 1991) "theory of involvement“ and "I-E-O model."
- The survey conducted to doctoral candidates, with a total of 12,138 students (including 1,850 students of engineering).
- Focus is Tinto’s 3rd stage: Degree completion/Exit stage(Research Experience).

Hypothesis of factors improving research productivity：

(a) Relationship with Faculty（Advisor）,
(b) Financial support (Travel Funds; Full Support),
(c) External commitment (Dependents)

- Analyzed these variables:

(I) Pre-entrance Information：Race/Ethnicity, Age, Gender,
Educational achievement of Father and Mother,
Dependents

(E) Research Environment： Financial Support(Travel funds, Full support),
Relation with Faculty and with Students,
Sense of Belonging

(O) Research Outcomes: Num of Research Presentation（On-campus, Off-campus),
Num of Refereed Articles

- Validated Tinto's hypothesis partially.

(1) Advisor faculty: On-campus research presentations, Peer-reviewed articles
(2) Travel funds : On/Off-campus research presentations
(3) Full Support : No statistically significant
(4) Dependents : Peer-reviewed articles (Positive effect)

Q&A

Q1. Why does travel funds affect on-campus presentations and peer-reviewed articles?
A1. Travel funds link to whole research projects.

Q2. Why does full support not have a statistically significant impact?
A2. Full support includes both teaching and research assistantships.
* From Appendix Table, the main financial support in the engineering field is RA (77%), TA (40%), and Institutional Fellowship/Stipend (35%).

Q3. Why are dependents having a positive impact?
A3. Because there are systems such as nursery school and dependent allowance.
* Walters (1965) describes about the dependent allowance as follows:
"this allowance should be as large as at present since it undoubtedly contributes to the size of families at a time when the population explosion is a major concern in all countries. " (p.144)

Appendix Financial Support Programs for the US Doctoral Students in the Engineering

(Up to 3 multiple answers)

		Partial or No Support	Full Sppot	Toal
National fellowship/scholarship	n	49	279	328
	%	16.7%	18.1%	
Institutional fellowship/stipend	n	87	533	620
	%	29.7%	34.5%	
Traineeship	n	6	38	44
	%	2.0%	2.5%	
TA：Teaching assistantship	n	107	614	721
	%	36.5%	39.8%	
RA：Research assistantship	n	179	1,187	1,366
	%	61.1%	76.9%	
Other assistantship	n	3	36	39
	%	1.0%	2.3%	
Internship/clinical residency	n	3	21	24
	%	1.0%	1.4%	

Source: Author made from NRC(2006) variables BROADFID, A12-1～14, A13.

Future tasks

1. Focus on other fields: This study focused on the engineering field.
2. Analyze Tinto's 1st and 2nd stage: This study analyzed 3rd stage.
3. Use more sophisticated statistical analysis: This study used multiple regression analysis.

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Thank you for your attention.

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