Collaboration between Universities and Society, Business & Industry in Doctoral Training

2018 Japanese- German Symposium
April 26-27, 2018 at Hitotsubashi Hall

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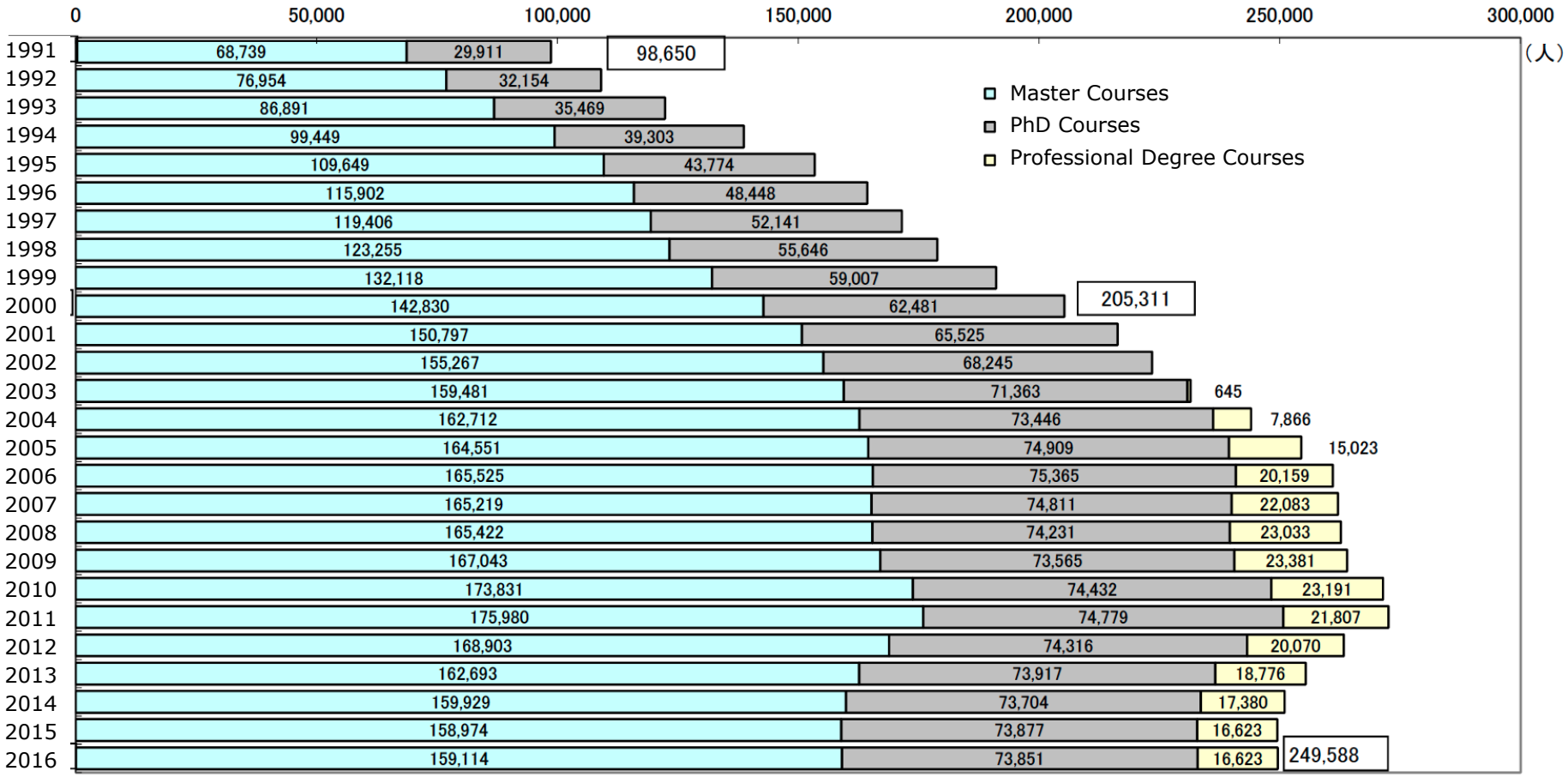
Tokyo Institute of Technology

Current Situation of Doctoral Education in Japan

Number of Graduate Students

Total number of graduate students rapidly increased in 1990's, in which 12 national universities reconstructed their education systems following the Japanese government's policy with overriding priority for the graduate schools. After that, however, the number of graduate students, especially in PhD course, was not particularly increasing.

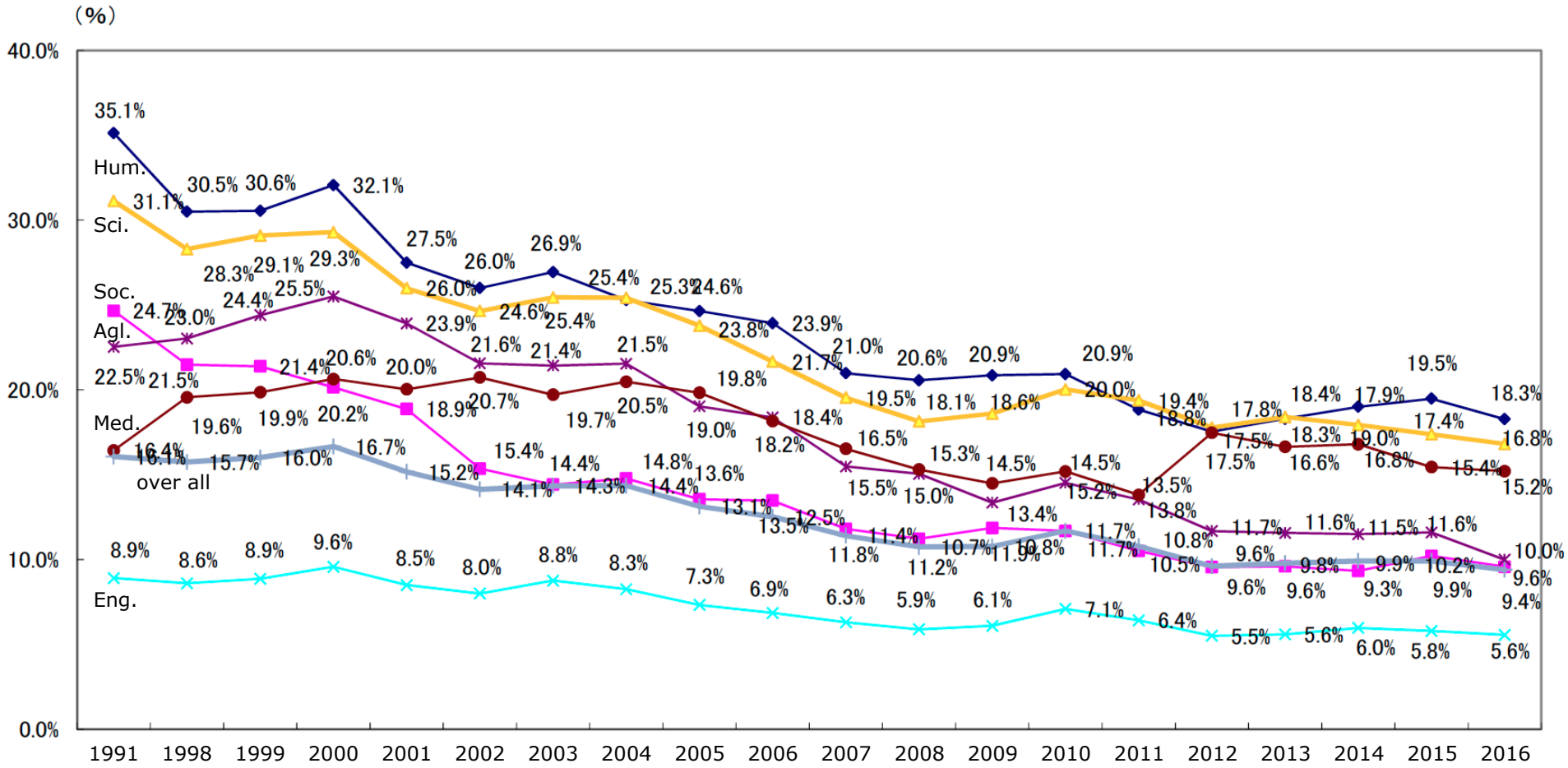


Data: Report on School Basic Survey, MEXT

Current Situation of Doctoral Education in Japan

Ratio of Enrollment in PhD Course from Master's Course

The ratio of PhD course enrollment is continuously decreasing in all disciplines.



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Current Situation of Doctoral Education in Japan

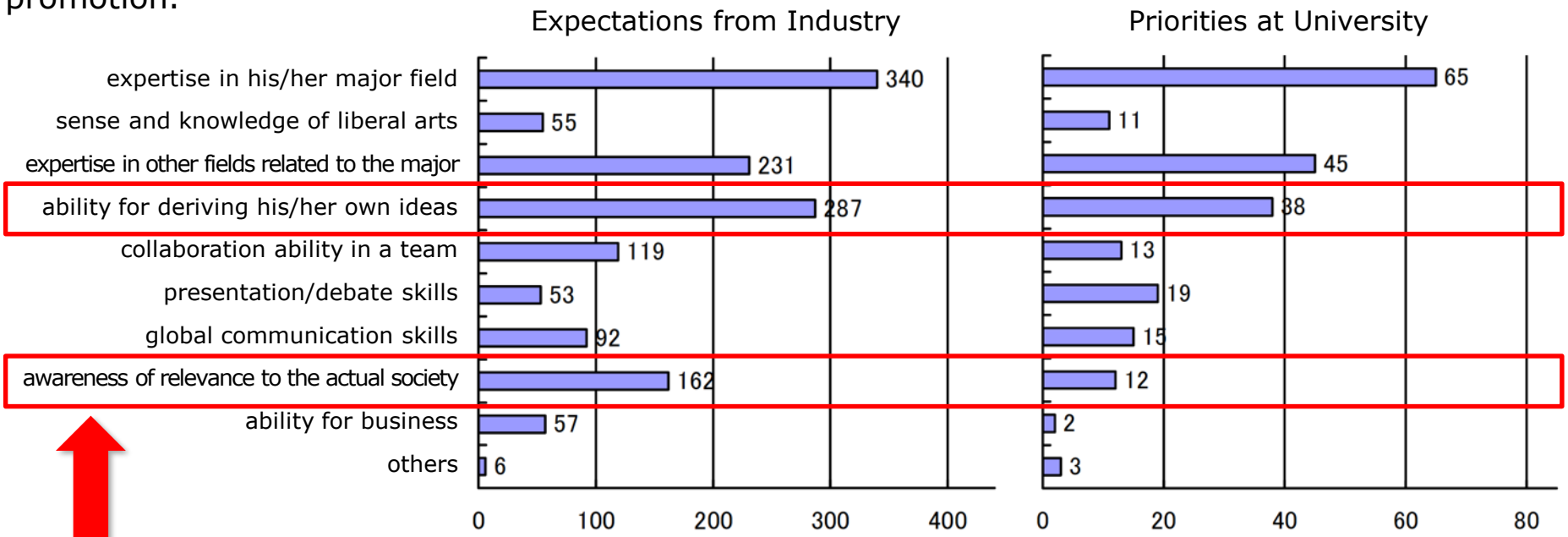
Why Not Go on to the PhD Course?

Master's course students may be afraid of narrowing their career paths if they got a PhD degree.

vicious cycle

- ✓ In general, PhD course programs in Japanese universities are based on research project in highly academic fields.
- ✓ Most of graduate students who intend to go on to the PhD course are aiming to be academic person.
- ✓ As the results, skills and abilities of PhD course graduates are not fit to those business and industry expect.

There are few companies that have specific routes and steps for PhD holders in their salary and promotion.



Data: Survey on human resource the industry wants, Japan Business Federation

There are obvious mismatches between educational priorities at university and demands of industry.

Desirable Ability for PhD Holders

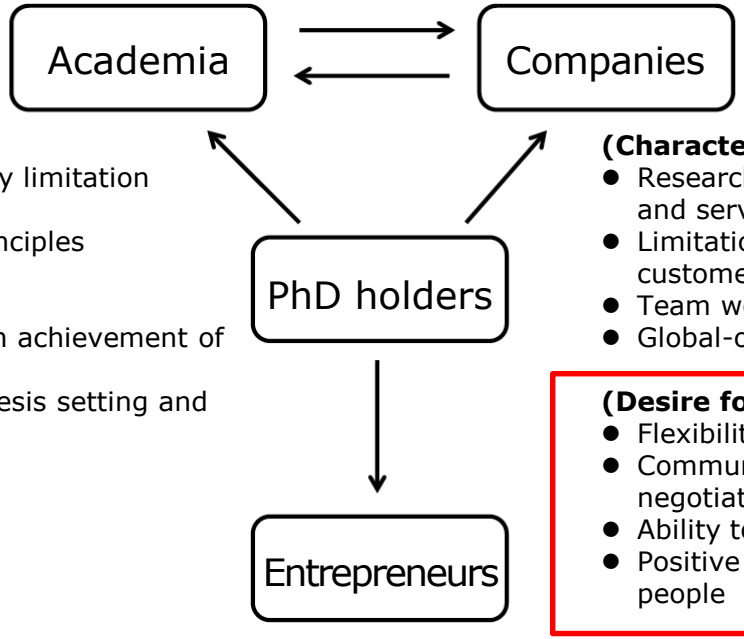
Opinions from the Industry

Industry in Japan are highly evaluating the abilities of PhD holders, such as expertise in their major fields, abilities of hypothesis setting and verification, successful experiences through achievement of research projects, and so on.

At the same time, industry feel unsatisfied at the positive attitude and flexibility toward new things and people, abilities of negotiation and coordination, etc; so-called "Transferable Skills."

In Europe, necessity of teaching and learning on Transferable Skills has been discussed in 1990's, and after 2000, many universities provide transferable skills training programs in PhD courses.

➡ **Japanese universities may fall at least 10-years behind !!!**



(Characteristics of Academia)
- Getting inspirations without any limitation
- Creation of academic value
- Exploration of fundamental principles

(Advantages of PhD Holders)
- Successful experiences through achievement of advanced research projects
- Well-trained abilities of hypothesis setting and verification
- Expertise in major field
- Attractiveness as a PhD holder
- Experience studying abroad

(Characteristics of Companies)
- Research aiming for development of products and services
- Limitations based on profitability and needs of customers
- Team working for commercialization
- Global-oriented

(Desire for PhD Holders)
- Flexibility not tied to the field of expertise
- Communication skills and abilities of negotiation and coordination
- Ability to convey in plain words
- Positive attitude toward new things and people

||

Transferable Skills

Chart: H. Shinoda, Y. Kanegae and T. Okamoto, NISTEP Discussion Paper No. 111 (2014)

Collaboration with Industry and Government

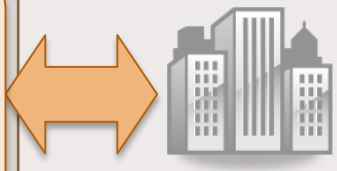
In Order to Break Through the Situation ...

Universities, industry and government, i.e. Ministry of Education (MEXT) and Ministry of Industry (METI), have started discussions on the desirable ways of human resource development in each sector.

MEXT MINISTRY OF EDUCATION, CULTURE, SPORTS, SCIENCE AND TECHNOLOGY-JAPAN	Universities	Industry	METI Ministry of Economy, Trade and Industry

Roundtable Meeting on Human Resource Development (2011~2012)
Under the support of MEXT and METI, top management from 20 companies and 12 universities discussed "action plans" for desirable human resource development in each sector, i.e. industry, universities and government.

Program for Leading Graduate Schools (2011~)
MEXT supports graduate schools that strive to create potential leaders who are capable of and disposed to take action on the global stage across a spectrum of platforms in industry, government, and academia.



strong collaboration with industry

Initiative of Industry-University Consortium for Innovative Human Resource Development (2013~)
METI supports a Consortium of 12 universities and 8 companies for providing graduate students with a chance of mid- to long-term Research Internship in industry with an "online matching system" for the research theme.

Collaboration with Industry and Government

Roundtable Meeting of Human Resource Development

Action Plans (abridgment):

Action #1

Enhance and reinforce education to foster human resources who can play an active role in the global society.

- Industry should support practical education through dispatching personnel as instructors, for example.
- Universities should provide lectures and seminars by personnel from industry who are active in global society.

Action #5

Enhance the development and utilization of innovative human resources to create new values and growth models in society.

- Industry should enhance initiatives to recruit and utilize the innovative human resources actively.
- Universities should promote initiatives to foster innovative human resources with extensive knowledge beyond the major fields of graduate schools.

Action #6

Foster human resources through collaborative research and education, and promote mobility of personnel between industry and universities.

Action in Government

Standing in a long-term perspective, it is essential to develop policies strategically for achieving outstanding human resources development, such as;

- securement of continuous and stable financial resources and facilities for education and research in university
- competitive and continuous support for universities that promote globalization, human resources development through industry-academia collaboration, and career development of doctoral students
- expansion of scholarships, and reform of donation tax system.

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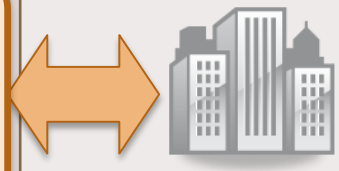

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Collaboration with Industry and Government

Leading Graduate Schools

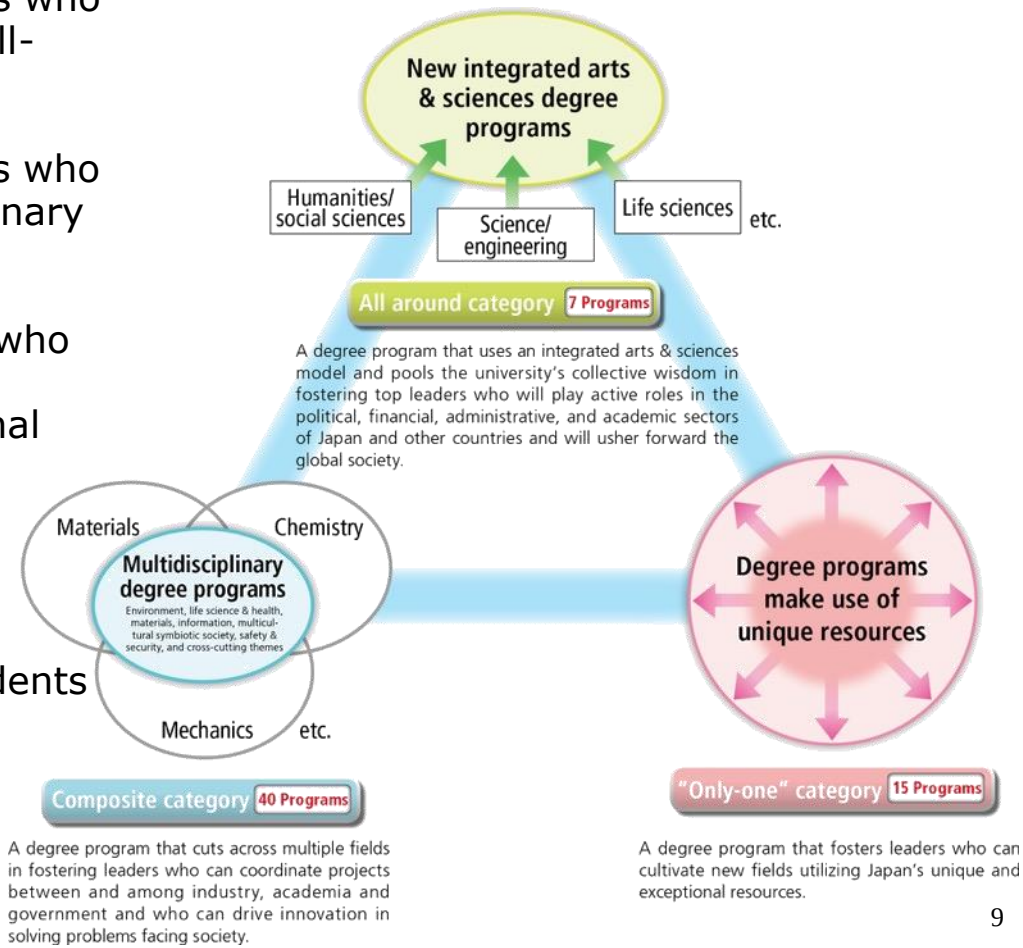
Selected degree programs are classified as one of three categories according to the human resources they are intended to develop and the kinds of issues they will address. The three categories are:

1) **All-around** category for cultivating leaders who will tackle global issues by applying their all-around knowledge and skills (7 programs),

2) **Composite** category for cultivating leaders who will create novel innovations in interdisciplinary fields (40 programs), and

3) **Only-one** category for cultivating leaders who will address issues in a field in which the university has particularly strong educational resources (15 programs).

In these programs, about 3000 graduate students are currently studying.



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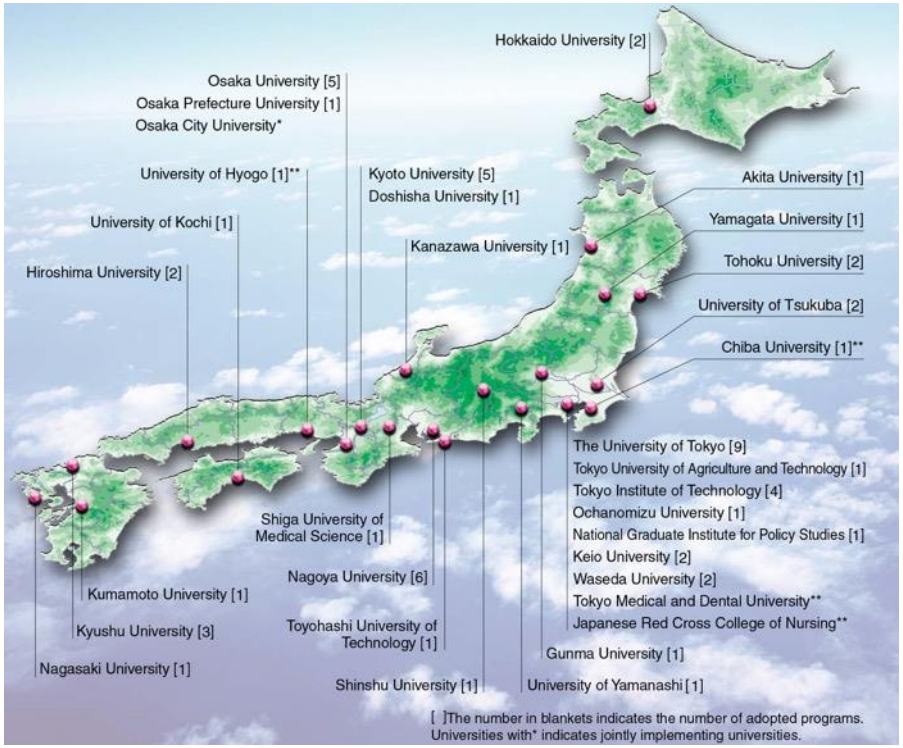

participating 33 universities

Collaboration with Industry and Government

Academy for Global Leadership

An example of the Leading Graduate School Program: Academy for Global Leadership (**AGL**) at Tokyo Tech, one of the all-around category programs, was launched in 2011 in collaboration with Hitotsubashi University.

AGL aims to foster graduate students' competencies required for top leaders who can take the initiative in business, economy, politics, or academia throughout the world.

Example of the competencies:

1. Research ability and creativity in a major academic field as a PhD holder.
2. Generalization ability and contextual intelligence among academic fields other than his/her major field.
3. Skills for cooperative engagement and international awareness.
4. Abilities for creative problem solving and to take action.
5. Spirit to take the initiative in the world.

Abilities/skills differ from knowledge:
a kind of
"**transferable skills**"

Academy for Global Leadership
Tokyo Institute of Technology

Academy for Global Leadership
A new education system in Tokyo Tech, launched in 2011

Collaboration with Industry and Government

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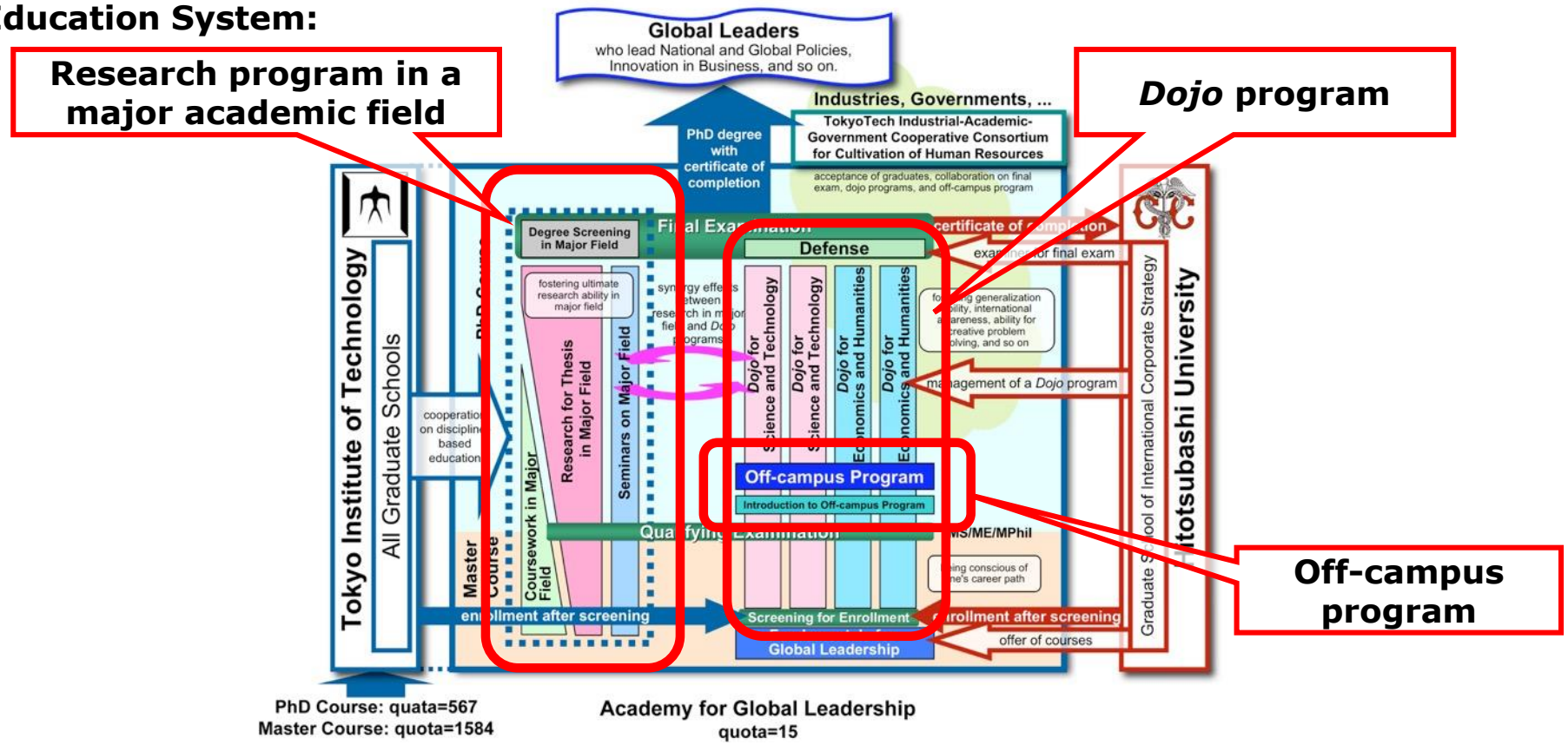
Education System:



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***Dojo* Program:**

- *Dojo*: a field for training in the students' transferable skills
  - ✓ In which diverse scholars from multiple academic disciplines work collaboratively to complete an unified project, for example;
    - policy proposals for ICT development
    - globalization in economic activities of industry
    - prevention of children's poverty issue
- Goal of the *Dojo* program
  - ✓ To hone students' skills necessary to become global leaders, such as cooperative engagement, creative problem-solving, open-mindedness and international awareness.

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Contents of the *Dojo* Program:

- 3 steps, 4.5-year-long program with flexibility in terms of semesters

Completion Projects
(Practical achievement)

- Propose a practical solution for the social issue to society
- Improvement of the solution based on the feedback from society

Collaborative Works
(Team-working and leadership)

- Solution for an unified social issue
- How the expertise of team members can be utilized to make the solution

Introductory Part
(Course work and debates)

- Awareness of social issues
- Discussions with personnel who are active in global society

strong collaboration with industry

NISSAN Innovation that excites
TOKYU CORPORATION
FUJITSU
AGC 旭硝子
astellas Leading Light for Life
NEC
HAKUHODO
KYODO 一般社団法人 共同通信社
FUJIFILM Value from Innovation
RICOH
AsahiKASEI

Collaboration with Industry and Government

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Off-Campus Program:

- Long-term internship in the "real world"
  - ✓ A cooperative education with industry/institution for 3 months or longer.
  - ✓ Through this program, students apply their abilities and skills to the practical project, to understand they have already learned and what areas require further learning.

- Examples of internship projects at industry:
  - ✓ Organic LED light source development, at *Konica Minolta, Inc.*
  - ✓ Support for new business development, at *Arthur D. Little Japan, Inc.*
  - ✓ New meteorological business development at, *Weathernews Inc.*
  - ✓ Building a mindset with its essential understanding through experiences of hospitality, at *Nippon HOTEL Co., Ltd.*
  - ✓ Communication activation in office space, at *Takenaka Co.*

- These project themes and companies are closely related to the students' career plans.

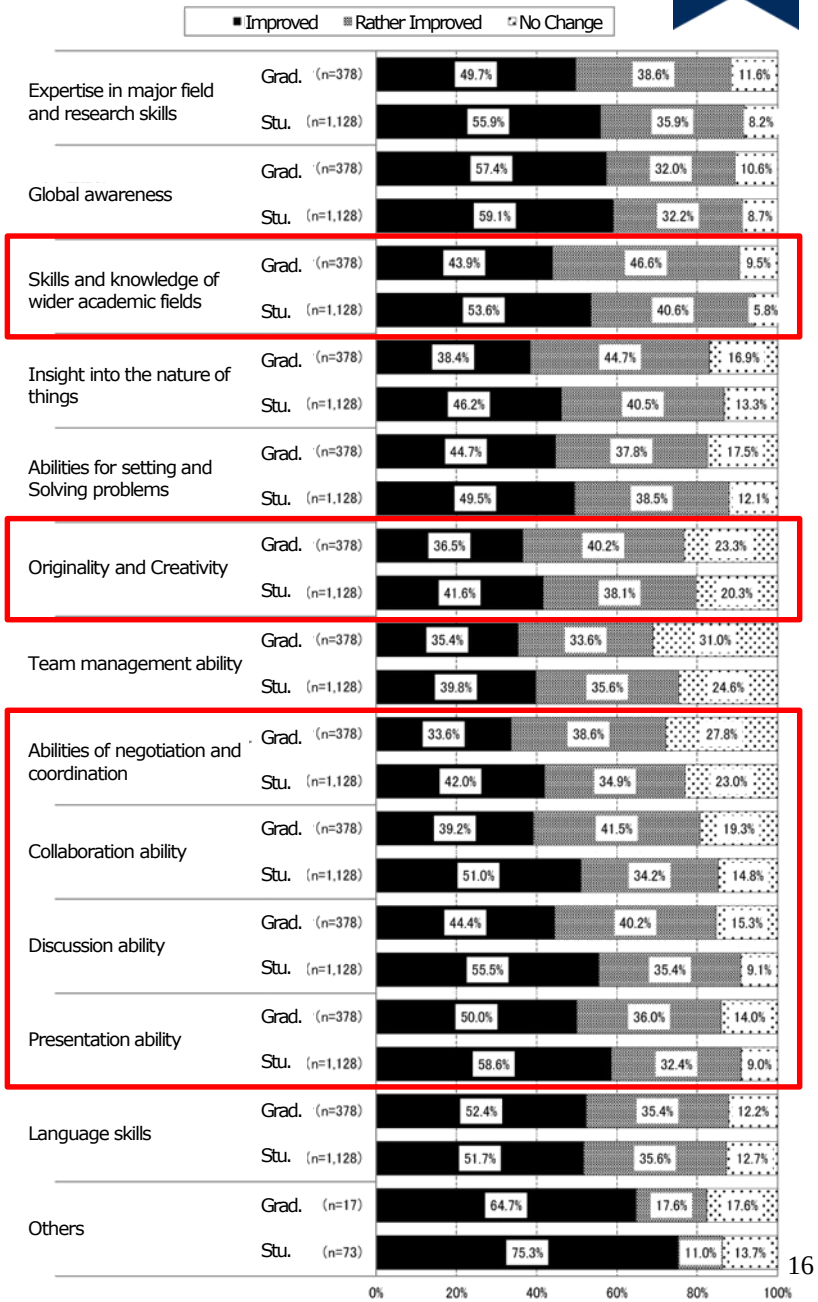
Collaboration with Industry and Government

Leading Graduate Schools

Students' self-assessment of the achievements:

The majority of students recognize the improvement of their competencies through the education program in Leading Graduate Schools.

- The competencies that industry want PhD course students to learn, such as flexibility not tied to the field of expertise, creativity, communication skills and abilities of negotiation and coordination, are markedly improved.



Data: JSPS questionnaire results, http://www.jsps.go.jp/

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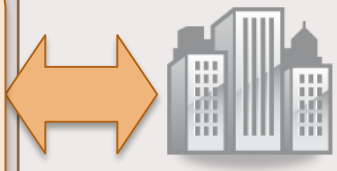

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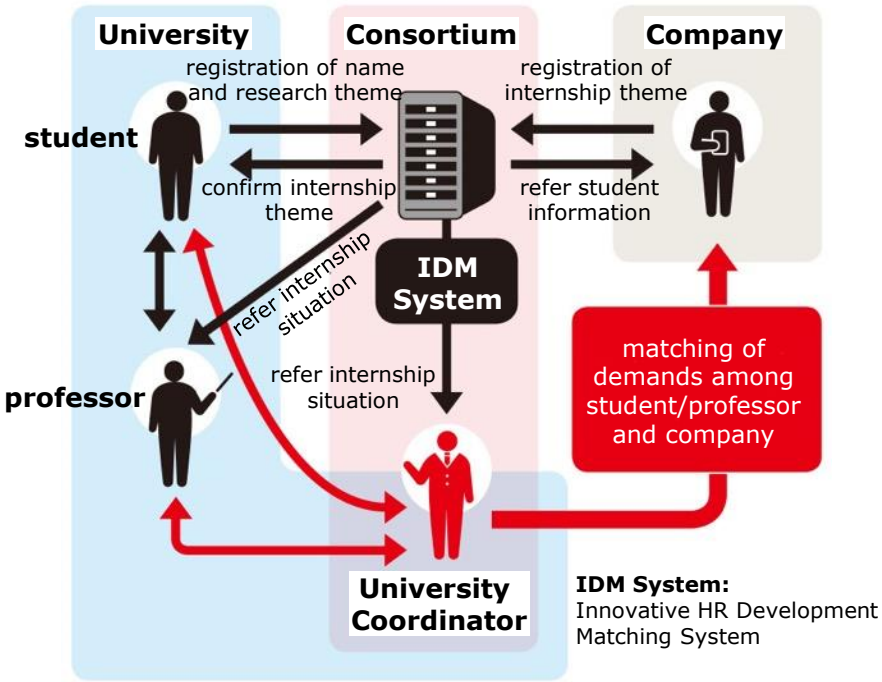
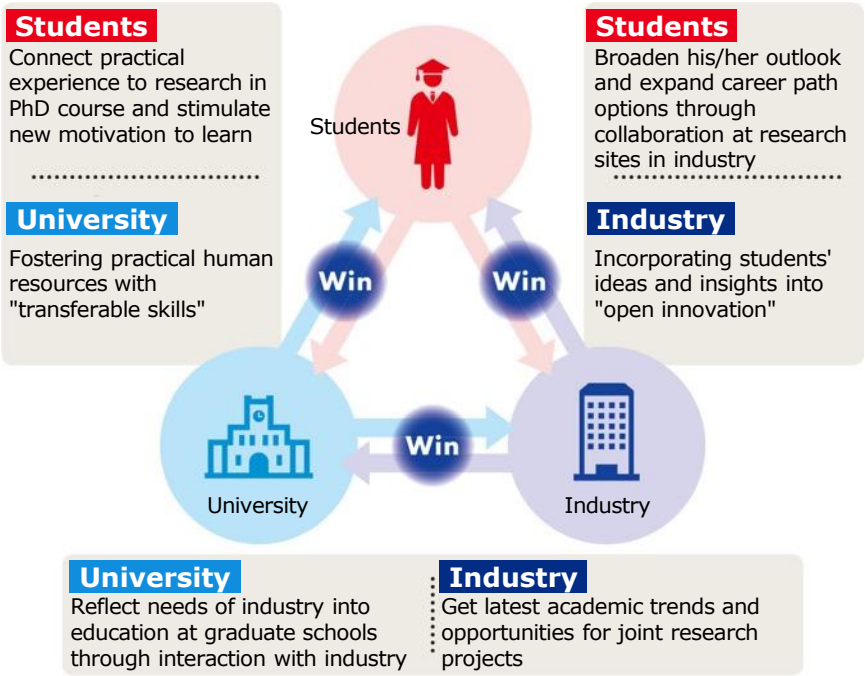
Collaboration with Industry and Government

Consortium for Innovative Human Resource Development

The consortium, **C-ENGINE**, of universities and companies provides a chance of mid- to long-term Research Internship in industry to graduate students. The feature of this consortium is the function for coordination of students' intention and career plan with theme of research projects in the companies.



C-ENGINE: Collaborative Education for Next-Generation INnovators & Exploration of knowledge intersections



As the results, mid- to long-term research internship can be implemented with all satisfactions of students, universities and industry.

Charts: C-ENGINE homepage, http://www.c-engine.org/

Collaboration with Industry and Government

Consortium for Innovative Human Resource Development

As of 2018, 14 universities and 30 companies form this consortium.

東北大学 筑波大学 東京大学 東京工業大学 早稲田大学
東京理科大学 お茶の水女子大学 京都大学 大阪大学 大阪府立大学
神戸大学 奈良女子大学 九州大学 鹿児島大学

Members from Universities

花王株式会社 京セラ株式会社 JNC株式会社 シスメックス株式会社 株式会社島津製作所 清水建設株式会社
住友化学株式会社 住友電気工業株式会社 住友電装株式会社 住友理工株式会社 住友林業株式会社 ダイキン工業株式会社
大日本印刷株式会社 株式会社竹中工務店 DMG森精機株式会社 一般財団法人電力中央研究所 東レ株式会社 株式会社巴川製紙所
株式会社日本触媒 日本ゼオン株式会社 株式会社日本総合研究所 日本電信電話株式会社 パナソニック株式会社 日立化成株式会社
富士フイルム株式会社 株式会社堀場製作所 三菱重工業株式会社 三菱電機株式会社 株式会社村田製作所 ヤフー株式会社
楽天株式会社 株式会社リコー ロート製薬株式会社 日立金属株式会社
オムロン株式会社 日東電工株式会社 ローム株式会社 ヤマハ発動機株式会社 株式会社タダノ 株式会社ABEJA

Members from Industry

Collaboration with Industry and Government

Consortium for Innovative Human Resource Development

An example of the log-term internship: A PhD course student of Tokyo Tech participated the research internship at the Foundation Technology Lab, Zeon Corporation for 3 months.

東京工業大学 × ZEON 日本ゼオン株式会社

The Student's point of view:
The student felt that he could acquire a new perspective and skills through a research project at the company that was independent from his thesis work.

The Company's point of view:
The company felt that the research internship done by the PhD course students was effective for exploring new fields of product in which the company could not invest the human resources much.


C-ENGINE研究インターンシップ詳細事例 Vol.1

専門とは異なる研究を通じて新たな視点・スキルを獲得

東京工業大学大学院総合理工学研究科 有機・高分子物質専攻 博士課程3年 鈴木優輝さん

インターンシップ実施概要

期間：2016年1月12～12月28日（3ヶ月）

受入企業：日本ゼオン株式会社 総合開発センター 基盤技術研究所

実施テーマ：複合材料による高分子物性と一次構造相関の解析

◆気軽に議論ができる風通しのよい職場環境より明確になった企業イメージ

◆大学では学べなかった研究の進め方

◆キャリアに対する新たな選択肢：様々な研究を管理できる人材をめざして

◆受入側にとっても新しい手法を用いた研究 一勉強しながら試行錯誤の毎日

企業の視点

学生の積極性・幅広い視点で双方にとってのスキルアップ

リソースを充当できないテーマ検討に研究インターンシップを活用

Q: 受け入れの流れについて教えてください。

Q: テーマ設定・目標設定はどのようにおこなわれましたか？

Q: 受け入れを通して感じたことを教えてください。

日本ゼオン株式会社 基盤技術研究所長 岸本 琢治 様

◆キインターンシップの実施プロセス

2016/7 学生と企業の交流会にて学生が企業担当者に相談

担当者が複数の研究所に打診。基盤技術研究所が受入検討を開始

2016/8 三者面談（学生、コーディネーター、企業担当者）

2016/8末 合格通知 メール等で時期・期間の調整 → 受入決定

大学・企業間での契約等事務手続き 保険等の確認、社内での調整など

2016/10～ インターンシップ実施

◆企業コメント◆ 日本ゼオン株式会社 総合開発センター研究企画管理部長 鈴木 輝彦 様

Effectiveness of the Collaborative Education

Viewpoints of Each Party

Students:

- ✓ They feel that the collaborative education program is effective for getting wider knowledge/skills and awareness of relevance to the actual society.😄

Faculty of Universities:

- ✓ Collaborative education with industry is indeed effective to foster the students' practical knowledge and skills.😄
- ✓ At the same time, however, they feel that the collaborative education is somewhat laborious and costly.☐

Member of Industry:

- ✓ It is desirable that the PhD holders acquire practical knowledge and abilities required in the companies.😄
- ✓ Collaborative education program may contribute to recruitment activity.😄
- ✓ However, planning of the projects for long-term research internship is sometimes difficult.☐

In general, evaluations of the collaborative education are basically positive.

If proper education is implemented, human resources with necessary abilities and skills can be trained, as the matter of course.

However, such kind of collaborative education is just started in Japan, and thus members of faculty and industry are bewildered by the **labor and costs** needed.

We really appreciate it if you could give us suggestions and/or hints for solving this issue!!

Tokyo Tech

Thank You