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Challenges for doctoral education in East Asia: a global and comparative perspective

J. C. Shin[1] · Gerard A. Postiglione[2,3] · K. C. Ho[4]

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Abstract
East Asian higher education is experiencing a massive growth in doctoral education with the world-class university initiatives. The growth of doctoral education in the region is remarkable especially as seen in the Chinese system which became positioned as the world's second largest doctoral degree-granting system. Yet, there are growing issues in doctoral education related to system reform, graduate employment in a changing job market, program quality, research funding, and even the identity of doctoral education (professional training vs. training next generation scholars). These are globally emerging issues for policy makers and higher education scholars. This article will encourage academic discussions on the challenges and global trends in doctoral education from the comparative perspective of Anglo-American and European systems.

Keywords Doctoral education · Doctoral training · Course work · Apprenticeship · East Asia · World-class university · Knowledge society

Introduction

Policy makers in East Asia have begun to pay as much attention to doctoral education (we use 'doctoral training' and 'doctoral education' interchangeably) as have their counterparts in Europe and North America. As the number of world-class ranked universities in East Asia has increased, so has the policy discourses on doctoral training as discussed in Shin and Kehm (2012). Research performance is heavily weighted in the ranking and competitive research is impossible without talented doctoral students and post-doctoral researchers. The policy initiatives for building world-class universities in East Asia, whether Brain Korea 21, China's 985 Project, Japan's Top Global University, is accompanied by systemic changes in doctoral training programs. However, the rich literature on the global rankings of world-class universities is not matched by academic discourses on the changes in doctoral education across countries in East Asia.

Training the next generation of scholars is highly specialized and there is limited room for external stakeholders in the process (Teichler 2006). Even professors in a discipline are rarely involved in doctoral training in other disciplines because each discipline has their own tradition for training their successors. However, the traditional systems of doctoral training in Europe and East Asian are being challenged to reform themselves (e.g., Sadlak 2004; Nerad 2010). The external requests for reforms are related to growing social demands for knowledge workers, especially in emerging professional areas (e.g., Austin 2010; OECD 2012). In addition, growing social interest in world-class universities contributes to policy discourses on reforming doctoral education. These changing environments lead to changing doctoral training systems from those based on individual professors or programs to more standardized systems across countries (Andres et al. 2015).

European discourse on doctoral education reforms has been influenced by the Bologna Process of 1999 which encouraged each country to adopt 3-year doctoral programs. The academic endeavor to understand these changes led to the publication of *Doctoral Studies and Qualifications in Europe and the United States: Status and Prospects* (Sadlak 2004). Compared with European systems, doctoral education

✉ J. C. Shin
jcs6205@snu.ac.kr

[1] Department of Education, Seoul National University, Kwanak-gu, Seoul, South Korea

[2] University of Hong Kong, Hong Kong SAR, China

[3] Beijing Normal University, Beijing, China

[4] Department of Sociology, National University of Singapore, Singapore, Singapore

in East Asian countries was not influenced by policy issues until the mid-1990s when the East Asian higher education race to build up a world-class university began to transform their universities from teaching institutions to research institutions, with the exception of Japan which already had a history of doctoral training program (e.g., UNESCO 2014).

Until the turn of the Century, a large proportion of doctoral degree holders in East Asia had earned their credentials abroad in the West (e.g., Shen et al. 2016; Teichler et al. 2013). However, East Asian countries began to actively train their next generation scholars and knowledge workers in their own universities from the mid-1990s (UNESCO 2014). These policy initiatives resulted in a massive growth of doctoral training in the region. Chinese doctoral training is positioned as the world's second largest doctoral degree-granting system according to the UNESCO data (2017). These changes imply that doctoral training is experiencing transformative changes in the region.

With the aim of enriching the academic discourse on doctoral training in Europe and North America (e.g., Nerad and Heggelund 2008; Sadlak 2004; Teichler 2006), this study explores the changing nature of doctoral training across countries with special focus on East Asia and highlights some challenges that need to be addressed.

Analytical frames and data sources

Analytical frames

This section overviews the changing environments of doctoral education and proposes analytical frameworks in order to understand implications of the changing trends and challenges. Doctoral education used to be the training ground for the next generation of scholars. However, doctoral training is now viewed as a training ground for a wide range of professional jobs in the knowledge society (Austin 2010; Andres et al. 2015) which has led to a remarkable growth in graduate education especially in the developing higher education systems. In her comprehensive overview, Kehm (2004, 2006) outlined the changing trends in doctoral training in Europe, and Nerad (2010) discussed 13 converging 'practices' across countries. Austin (2010) also proposed two areas of reform issues of doctoral education—preparing for diverse employment options and reforming the structure and nature of doctoral education in the US, specifically focusing on STEM fields. Andres et al. (2015) proposed three global drivers of doctoral education—massification, professionalization, and the introduction of quality assurance. These trends and challenges provide insights on the contemporary and changing trends as well as the challenges facing doctoral education.

In this article, we organize these changes around two key factors—massification of higher education and the knowledge society. The massification of higher education expanded the pool for master and doctoral degree seekers. Readers are reminded that in Europe a diploma was given to students when they completed 5 years of university education and this is equivalent to a master degree in current education systems following the Bologna Process established in 1999. With the growing pool of advanced degree programs thanks to mass higher education, doctoral education enrollment has increased significantly, especially in the systems where doctoral education was previously underdeveloped. For example, doctoral degree recipients have increased 24 times in Malaysia, 5.5 times in Mexico, 3.5 times in Thailand, 2.4 times in the UK, and 1.7 times in the USA during last 15 years between 2000 and 2015 according to UNESCO data (UNESCO 2017).

Mass higher education reflects the changes in student demographics (gender, part timers, aged students, etc.) as discussed in Shin and Harman (2009). Similarly, the rapid growth of doctoral education drives changes in student demographics (Kehm 2004). For example, we can imagine that female doctoral students are the main driver of the rapid growth of doctoral education. With changing student demographics, funding support became a serious policy issue especially in the countries that charge student tuition because the number of socially under-represented doctoral students is increasing. As a consequence, doctoral programs are becoming increasingly standardized and the quality issue cannot be ignored as we have seen in mass higher education development (Andres et al. 2015). A noticeable consequence of doctoral education is that the market value for a doctoral degree may be declining. In other words, scarcity of doctoral degree is declining in the society.

The second key factor leading transformative changes in doctoral education is the knowledge society and the rapid development of ICT technology (Nerad 2010; Teichler 2006). The knowledge society has led to the creation of new job markets such as research and development (R&D) jobs (e.g., Mars et al. 2014). Doctoral degree holders are working in various types of R&D industries, e.g., project development, management, proposal writing, technology transfer, spin offs, consulting, etc. In addition, technological development in ICT industries has created new types of jobs such as data management and analysis, e-government, e-commercial, and even e-banking. (e.g., OECD 2012). The University as a center for innovation is expected to train students these new areas of work. However, this has required changes in the existing doctoral education systems.

The new environments require universities to offer new programs focusing on the areas of the knowledge economy (Mars et al. 2014; Melin and Janson 2006). In addition, the

knowledge economy prefers a shorter time to earn a degree because knowledge and technology change so rapidly and degree requirements should therefore be lessened accordingly. Doctoral training began to emphasize broader competence, and academic disciplines based on more narrow knowledge and skills were insufficient to meet the new social demands (Austin and McDaniels 2006). These societal perspectives are strongly encouraged by such metaphors as social engagements, knowledge/technology transfer, service, third mission, entrepreneur activities, or social contributions (e.g., Etzkowitz and Leydesdorff 1997; Gibbons et al. 1994; Slaughter and Rhodes 2004). However, universities that used to train their successors for academic jobs are ill prepared to respond to these changing social demands (Gardner et al. 2012; Mars et al. 2014). In the new environment, professors struggle with the identity of doctoral education between training the next generation scholars and training professionals for the knowledge economy (e.g., Cassuto 2015; Boud and Tennant 2006).

Figure 1 represents how the massification and knowledge society discourses are related to the changing trends of doctoral education and its challenges.

Data sources

This study relies primarily on empirical data in examining changing trends in doctoral education and the challenges that it confronts. The study draws on comparable data from various countries as a basis for the discussion. Our primary data sources are international data from UNESCO (2017) and OECD (2017). Although both international organizations developed data collection systems for primary, secondary, and tertiary education, the tertiary education data include some reliable data for doctoral education. For example, the data provide information on doctoral enrollment by gender, mobile status, major areas, and job market information for doctoral education. We selected representative doctoral training systems for our analysis including four European systems (Germany, France, Italy, and Sweden), four Anglo-American (USA, UK, Canada, and Australia), and four from East Asia (Japan, Korea, China, and Malaysia). We did not stay with these 12 systems because some do not provide doctoral education data.

Because the national statistics from UNESCO/OECD do not go deeply into doctoral education practices, a comparative survey might be useful in gaining a deeper understanding of doctoral training practices. The Changing Academic Profession (hereafter, CAP) 2007/2008 in which 19 systems across six continents provided information on doctoral training (Teichler et al. 2013). The data come from major doctoral training systems including Anglo-American, European, Latin American, South African, and East Asian systems. This is one of few data sources that provide information on doctoral training across various countries. The survey includes academics' doctoral training experience when they were doctoral students. The CAP data contain more than 20,000 cases and we selected 2744 academics who had earned their doctoral degree within the previous 5 years (2003–2007) in order to source data from relatively recent doctoral candidates.

In addition, we conducted a survey to gather in-depth information from doctoral students. The survey was conducted in 2015/2016 by the authors of this study (Shin et al. 2015), and includes doctoral students' motivation for doctoral study, their perceived competence, their satisfaction with their programs, and their plan for entering the job market after degree completion. The participating universities are National University of Singapore, the University of Hong Kong, and Seoul National University. In addition, one US research university was included in the research project. These four universities have comparable global reputations and we assume their doctoral training to be also comparable

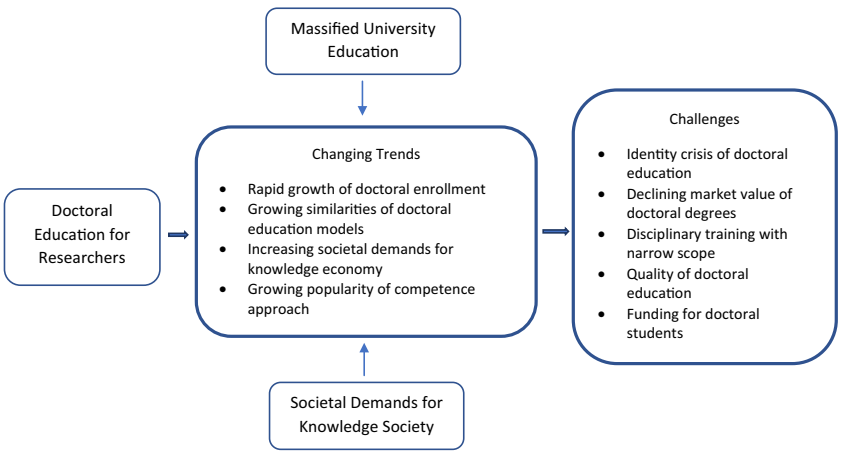

Fig. 1 Conceptual frameworks

(the four universities were ranked within the top 200 according to the QS rankings in 2016). Each university provided more than 300 cases which resulted in 1671 observations. In addition, this study utilizes other data sources that provide national statistics on doctoral education, especially the US National Science Foundation (2017) provides data on doctoral education.

Changing trends in doctoral education

This section focuses on the changing trends in doctoral education from a global and East Asian perspective. The changing trends are summarized in four areas: rapid growth of doctoral education across countries, growing similarities of the doctoral training model across countries, the changes accompanied by the increasing social demands for knowledge industry, and the growing popularity of competence-based doctoral education.

The rapid growth of doctoral enrollment

Doctoral education has grown rapidly during the last two decades. The share of doctoral degree holders has reached 1.0% of the OECD countries in 2016 among the aged 25- and 65-year-old population. US universities granted 67,449 doctoral degrees in 2015, followed by 54,891 in China. In 2015–2016, of the more than 1 million foreign students who enrolled at universities in the United States, about 35% were Chinese, including 128,320 who were enrolled as postgraduates (Open Doors, Institute of International Education 2017). The growth of European doctoral training systems has been relatively stable in Germany, France, and Sweden from 2000–2015 according to UNESCO. The stable growth of doctoral education in these countries might be related to factors in the job market and or to a conservative admissions approach in order to protect the quality of education. However, UK, Australia, and Canada have reported more than double growth rates over the same period. This increase in doctoral enrollment is related to the influx of foreign students. The East Asian systems (Malaysia, Thailand, Indonesia, Philippines, and Korea) have also experienced a rapid growth in doctoral education as shown in Table 1.

The increase in doctoral education is seen in an analysis of the demographics. For example, women and foreign students accounted for relatively few doctoral candidates in the past, but their percentage has been growing. The percentage of women doctoral students was well below 50% in many countries, but is now approaching 50% in some countries such as USA, Australia, Italy, UK, and Sweden as shown in Table 2. However, women are highly underrepresented in East Asian countries (Japan, Korea, China, and Malaysia) where the percentage is much lower than for men as shown in Table 2. In addition, the percentage of foreign doctoral students is over 30% of the total in some Anglo-American systems (USA, UK, and Australia) as well as in some European countries (France, Sweden, and Switzerland). The share of international students is much higher at doctoral education level compared with that for undergraduate education. The fact suggests that doctoral education and graduates' job market are much more internationalized than undergraduate education. Yet, the percentage of foreign doctoral students is relatively low in Japan and Korea. Those countries with large numbers of foreign students provide courses in English or other languages, making them much more attractive to foreign students (e.g., Shen 2016). For example, the percentage of foreign doctoral students is over 60% in Singapore and 70% in Hong Kong, where English is the medium of instruction.

The rapid growth of doctoral students is closely related to industrial development in the region. For example, knowledge- and technology-intensive industries (including commercial and public knowledge industries, and hi-tech manufacturing industries) account for 28% of the global GDP according to the US National Science Board (US National Science Foundation 2016). This is much higher in developed economies (34%) compared with developing economies where it averages 20%. The close link between doctoral training and economic strategy is notable in state-centered systems such as Japan, Korea, China, Taiwan, and Singapore. This set of countries has had a recent history of industry-driven growth and seen science and technological innovations as an essential way of moving staying ahead in economic development. In these countries, higher education is twinned with science and technology policies as universities are expected to work with industry to develop commercially viable products (Wong and Goh 2012).

Shin (2012) highlighted how education development including graduate education is related to economic development strategy in Korea. Singapore developed a world-class university and doctoral training program that aligned with economic development priorities of the country in terms of knowledge-intensive sectors tied to its industries (Sidhu et al. 2011). Hong Kong's doctoral training strategy has only recently become more aligned with regional industry. The Education Bureau is putting $3 billion toward studentships to increase the number of local doctoral students in UGC-funded research postgraduate programs. The Innovation and Technology Bureau allocated a $500 million "Technology Talent Scheme," including a "Postdoctoral Hub," and $700 million will be invested for projects to develop Hong Kong into a Smart City (University Grants Committee 2017).

Table 1 Growth of doctoral degree recipients (2000–2015)

	2000	2005	2010	2015	Growth rate (2000–2015) (%)	Share of doctoral degree aged 25 or older (2015) (%)
Malaysia	148	568	1268	3569	2411	
Mexico	1036	2432	4167	5782	558	0.2
Slovakia	446	1022	2878	1914	429	0.7
Thailand	576	1283	2989	2015	350	
Ireland	501	810	1222	1738	347	
New Zealand	464	643	987	1332	287	0.8
Slovenia		369	465	1000	273	1.8
Philippines	1292	1522	1622	3427	271	
Italy	4044	8466		10,678	265	4.0 (2016)
Indonesia			2260	5363	264	
UK	11,566	15,778	18,756	26,636	237	1.2 (2016)
Australia	3802	4,931	6079	8400	230	1.3
Norway	658	838	1202	1407	221	0.9
Canada	3978	4200	5673	7059	214	
Korea	6143	8449		12,931	210	0.2
USA	44,808	52,631	69,570	67,449	177	1.7
Portugal	1586	4150	2927	2351	151	0.5
France	9903	9818		13,774	148	0.8
Japan	12,192	15,286	15,867	16,039	139	
Germany	25,780	25,952	25,629	29,218	132	1.3
Sweden	3049	2778	3371	3345	113	1.2
China				54,891		
India				22,528		
Hong Kong[a]	1486	1745	2051	2314	155	

Data sources: (1) UNESCO doctoral graduates each in 2000, 2005, 2010, and 2015 are at http://data.uis.unesco.org/, (2) the data for Italy and the UK are from OECD statistics in 2016 (Educational Attainment and Labor Force Status) at https://doi.org/10.1787/889e8641-en, (3) Hong Kong data are from Hong Kong University Grants Committee at https://cdcf.ugc.edu.hk/cdcf/statEntry.do?language=EN, (4) The share of doctoral degree aged 25–64 based on OECD data

Growing similarities between doctoral education models

There are two major doctoral training models, the USA model and European model. The US model has a heavy coursework component, as well as a qualifying exam and dissertation leading to the doctoral degree. The standard procedures related to admission, coursework, the qualifying exam, the research proposal, and the dissertation stages (e.g., Weidman et al. 2001). Coursework is critical because the program requires students to take pre-determined courses particularly in relation to knowledge in their fields and research skills. This is a distinctive characteristic of the US doctoral programs (e.g., Altbach 2004; Cummings and Bain 2018). In addition, students are encouraged to actively participate in teaching (as a teaching assistant or instructor) and research (as a research assistant) to develop their teaching and research skills. Through the active participation in teaching and research activities, doctoral students develop their teaching and research competence (e.g., Austin 2002; Coppola 2009; Nyquist and Sprague 1992). The template for doctoral training is similar across universities and disciplines in US higher education.

European doctoral training relies heavily on the supervision of an 'individual' professor and the system constitutes an 'apprenticeship model' (Schneijderberg and Teichler 2018). Doctoral students are not given pre-determined coursework but they take some methods courses based on their own needs or as recommended by their supervisor. Courses are not mandatory for doctoral students; instead they often participate in seminars given by their professor and other doctoral students. In this model, a close relationship between doctoral students and supervisors is critical for successful doctoral studies. In addition, doctoral candidates often participate in research projects and their participation in research project provides invaluable experience for their research career development. Their doctoral degree depends principally on the dissertation and there are few official

Table 2 Growth of female and foreign doctorates

	Female doctoral graduates (%)		Foreign student enrollment (%)
	2000	2014	2015
France	41	45	40
Germany	34	45	9
Italy	51	52	
Sweden	37	46	34
Switzerland	31	43	54
Australia	41	50	34
Canada	39	45	29
UK	38	47	43
USA	44	50	29
China		38	
Hong Kong[a]	37	42	80
Japan	19	31	19
Malaysia	30	41	
Korea	20	35	9

Data Sources: (1) Female doctorate graduates from UNESCO, and foreign doctoral enrollment from OECD, (2) Hong Kong data are from Hong Kong University Grants Committee at https://cdcf.ugc.edu.hk/cdcf/statEntry.do?language=EN, (3) US data are the share of temporary visa holders among the doctoral degree recipients in 2015 (data source: doctorate recipients from US Universities: 2015 (https://www.nsf.gov/statistics/2017/nsf17306/)

requirements for doctoral degrees. According to Kehm (2004) and Nerad (2010), this system has been undergoing changes because of the growing number of European universities beginning to adopt coursework components or some element of the standardized systems after the Bologna Process.

Compared with the Europe, East Asian doctoral training has developed into different systems depending on how their original models of education functioned (Shin et al. 2018). The Japanese model of doctoral training is similar to the German though Japan incorporated some components from the US doctoral education (e.g., Arimoto 2018). A similar model was also adopted in Korea and Taiwan, but both adopted systems much closer to the US doctoral education. The Chinese model of doctoral training was rooted in the former Soviet system, until China began to adopt aspects of the US doctoral education (Huang 2018). In addition, Malaysia, Singapore, and Hong Kong (all former British colonies) have adopted the British model of doctoral training which is a dissertation-based system with components of coursework.

Although the two training models differ, each East Asian system combines the components of each model in some way. The CAP survey data on doctoral graduates who completed their doctoral studies between 2004 and 2007 show that some systems emphasize both coursework and intensive supervision, while others are weaker in both coursework and intensive supervision, as shown in Fig. 2. This suggests that there is a growing convergence toward a combination of both coursework and intensive supervision. The data also show that four of the ten European countries (Italy, Sweden, Spain, and Finland) have already adopted some components from the coursework-based systems while six others (Germany, Netherlands, Austria, France, Belgium, and Switzerland) less so. At the time of the data collection, the British systems (UK, Australia, and New Zealand) placed less emphasis on coursework.

The five East Asian systems display various patterns of coursework provision and intensive supervision. Three East Asian systems (Korea, China, and Hong Kong) provide both coursework and intensive supervision while two other systems (Japan and Malaysia) provide relatively weak coursework and supervision. The data suggest that Korea, China, and Hong Kong train their doctoral students through coursework and intensive supervision, while Japan and Malaysia have kept their original models of doctoral training (German and British). However, growing numbers of universities in

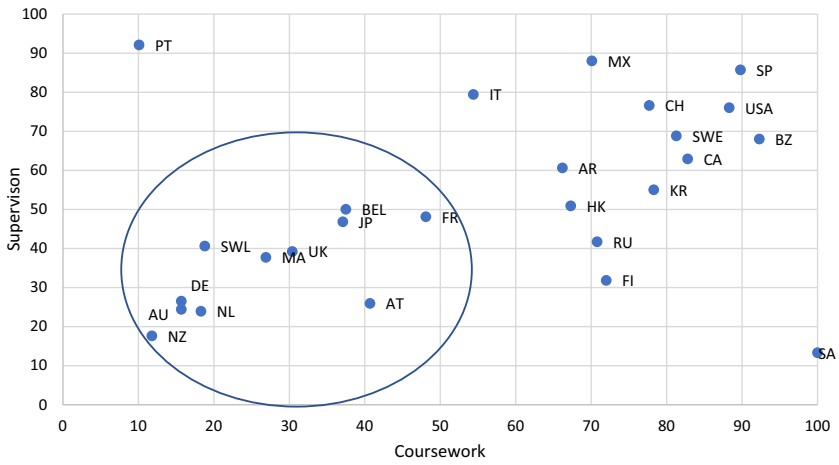

Fig. 2 Patterns of doctoral training: coursework versus intensive supervision. *Data source* The Changing Academic Profession 2007/2008. *Notes AR* Argentina, *AT* Austria, *AU* Australia, *BEL* Belgium, *BZ* Brazil, *CA* Canada, *CH* China, *DE* Germany, *FI* Finland, *FR* France, *HK* Hong Kong, *IT* Italy, *JP* Japan, *KR* Korea, *MA* Malaysia, *MX* Mexico, *NE* Netherlands, *NO* Norway, *NZ* New Zealand, *PT* Portugal, *RU* Russia, *SA* South Africa, *SP* Spain, *SWE* Sweden, *SWL* Switzerland, *UK* United Kingdom, *US* United States

Japan and Malaysia have adopted coursework components in their systems (e.g., Arimoto 2018). In addition, we can observe that there are much difference between East Asian doctoral education and the US doctoral education. For example, the master degree is quite relatively delinked from doctoral education in Japan, Korea, and Taiwan while it is more closely linked to doctoral education in the US. For example, some students can enter a doctoral degree program with a bachelor degree and earn a master degree as part of the progress.

Increasing social demands for knowledge industry

Discussions about the knowledge society have had a significant impact on doctoral training systems in Europe and East Asia. The core of the discourse centers around the close links between university research and society whether it is called entrepreneur activities, social engagement, or service (e.g., Cummings and Bain 2018; Mars et al. 2014; Mendoza 2007; Slaughter et al. 2002). These new industrial areas require well-trained human resources in globally competitive business environments. Providing new programs for training knowledge workers is highly encouraged by policy makers (Lee et al. 2009; Melin and Janson 2006; OECD 2012). In addition, the knowledge industry has developed rapidly with ICT technology. For example, total R&D personal per thousand employees is 17.5 in Sweden, 17.4 in Korea, 16.1 in France, 15.2 in Germany, and 13.9 in Japan, according to UNESCO data in 2015 as shown in Table 3. Doctoral training has become more than training of the next generation of researchers. It is more about training knowledge workers. In reality, due to rapid societal change, a majority of doctoral degree holders are being employed by outside of academia in some European systems (e.g., Switzerland, Germany, Sweden, etc.) (e.g., Schneijderberg and Teichler 2018), as well as in the USA. In short, external pressures have had a huge impact on doctoral training programs.

Doctoral training is therefore shifting its focus from training for scholars to training knowledge workers in economically valuable and relevant fields, or in the entrepreneur dimensions of existing fields. This change has led to new programs with interdisciplinary perspectives and a strong emphasis on innovation and entrepreneurship (Austin 2010; Carney et al. 2006) leading to an increase doctoral students and new types of doctoral degrees in the professional areas (e.g., Andres et al. 2015; Lee et al. 2009). The composition of doctoral training has changed with the strong emphasis on the STEM fields which are closely linked to industrial development and innovation (Austin 2010). OECD data (2017) show that the share of doctoral students in STEM (sciences, technologies, engineering, and mathematics) in 2015 grew by more than 60% in most countries except in the USA.

Table 3 Total R&D personnel per thousand total employment (FTE)

	2000	2005	2010	2015
France	13.7	13.8	15.3	16.1
Germany	13.0	13.1	14.3	15.2
Italy	7.2	7.7	10.0	11.3
Sweden	16.1	17.7	17.0	17.5
Australia	10.6	12.1	12.7	12.7
Canada	11.1	13.3	13.4	12.5
UK	10.4	11.2	11.9	13.2
China	1.3	1.9	3.4	4.9
Japan	14.0	14.2	13.9	13.9
Korea	6.5	9.5	14.0	17.4
Hong Kong	3.0	6.5	6.9	7.3
Malaysia	1.1	1.7	4.3	5.8
Singapore	10.0	12.8	13.5	14.0

Data source: UNESCO Human Resource data from http://data.uis.unesco.org/

Table 4 Growth of doctoral degree recipients age 30 or under

	Doctoral graduates age 30 or under (number)			Growth rates (2005–2015) (%)
	2005	2010	2015	
Australia	197	375	520	264
Austria	218	226	257	118
Canada	311		814	262
Czech Republic	130	218	323	248
Denmark	123	127	248	202
Finland	116	103	132	114
France			1115	
Germany	2863	3200	3841	134
Hungary	62		123	198
Italy	1013	988	1251	123
Korea		427	679	159 (between 2010 and 2015)
New Zealand	43	59	85	198
Norway	61	74	99	162
Portugal	53	108	126	238
Slovak Republic	55	180	101	184
Spain	373	547	1062	285
Switzerland	302		512	170
United Kingdom	714	4563	1656	232

Data source: OCED Doctoral Graduate Age data in 2015

In addition, the emphasis has shifted to a shorter doctoral degree training period because of the relatively short life span of knowledge and technology in these fields (e.g., Jones 2018; Kehm 2006). Doctoral students in the new fields are not interested in taking longer training period in their doctoral studies than necessary. They aim to enter the job market and recover the financial cost of their study as soon as possible. In most systems, a university encourages professors to grant a doctoral degree within a given time period (e.g., 3 years according to the Bologna Process). As shown in Table 4, doctoral degree recipients are now much younger than before. The total number of doctoral degree recipients aged 30 or under has increased 1.9 times in selected OECD countries.

Growing popularity of a competence-based approach

The knowledge society requires a broad range of competence as well as disciplinary knowledge and skill (e.g., Barnett 2004). The newly required skills are related to skills for interpersonal relationship, collaboration, project management, human resource management, etc. (e.g., OECD 2012). Disciplinary knowledge used to be the core of the doctorate, but the current approach favors a much wider concept than just disciplinary knowledge. Competence was developed to explain ability, knowledge, and skills in the professional fields, and it is widely applied in education though there are controversies about the competence or generic skills (e.g., Gilbert et al. 2004). Competence is a core part of doctoral training because general competence is critical for new areas such as social engagement, entrepreneur activity, and public intellectual (e.g. Austin 2010; Green 2009). Although each of them emphasizes different dimensions of doctoral students' competence, the competence perspective highlights the need for skills other than teaching and research.

This perspective requires fundamental changes in doctoral training programs from disciplinary knowledge and skills to a broader range of skills, techniques, knowledge, attitudes, etc. Austin and McDaniels (2006) proposed four areas of competence (conceptual understanding, knowledge and skills in areas of faculty work, interpersonal skills, and professional attitudes and habits) that doctoral students are expected to develop. Among these, conceptual understanding is related to disciplinary knowledge and skills and the other four areas to various experiences such as teaching, research projects, industry–university partnerships, and academic conferences. However, doctoral students are not well prepared even for teaching (Coppola 2009). According to the CAP data, almost 40% of doctoral degree recipients stated

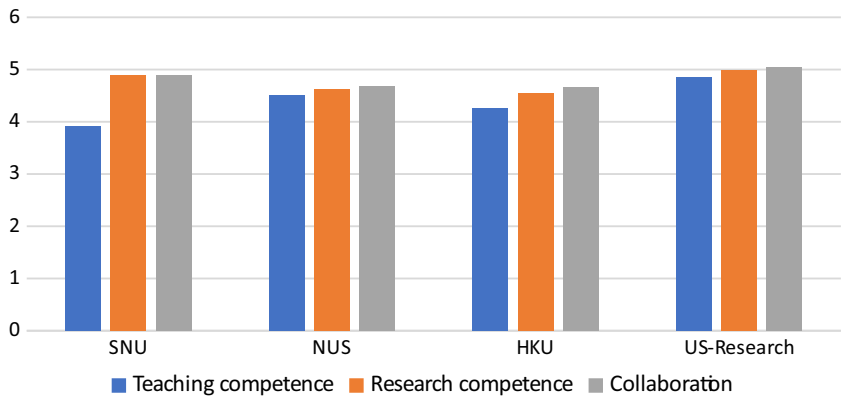

Fig. 3 Competence of Doctoral Students. *Data source* Shin et al. (2015). Graduate Students Survey. Unpublished test, Seoul National University, Seoul, South Korea

that their doctoral program did not provide any program for teaching skills with the only exception being South Africa (Teichler et al. 2013).

The survey conducted by the 'Comparative Study of Doctoral Students in Asian Flagship Universities' provides rich information of self-reported competence of doctoral students in East Asia. The survey also includes a research-intensive research university, which is a 'Big 10' university in the US. According to the survey, doctoral students assessed their competence as similar to the invited US research university in 'research' and 'collaborative work,' as shown in Fig. 3. Since the 1990s, these three leading East Asian universities joined the global races for building a world-class research university and in the process they placed a greater and greater emphasis on doctoral training. The figure demonstrates that these leading East Asian universities have established competitive doctoral training programs, making them similar in this respect to the US research university. An interesting finding from the comparative study is that doctoral students' teaching competence is relatively lower in the three East Asian universities in comparison with the selected US university. The higher teaching competence of US doctoral students is at least in part related to institutional efforts to enhance teaching competence of research professors and their doctoral students since the publication of Boyer's *Scholarship Reconsidered* in 1990.

However, teaching competence among the three East Asian universities also differs from 3.9 point at Seoul National University (SNU) and 4.5 point at National University of Singapore. The finding implies that SNU may be less focused on preparing their doctoral students for teaching jobs with greater focus on their training as researchers. On the other hand, National University of Singapore is relatively well established to train their doctoral students as a balanced scholar. The higher teaching competence for NUS is tied to its long history as the country's only national university, which places as heavy responsibility on it as the main institution for the education of the country's elite. With a sustained focus on teaching responsibility, it faces fresh challenges internationally as a research university. As a result, graduate students spend significant hours per week teaching undergraduate students alongside their professors. Although the data are based on the comparisons between three selected East Asian universities and one research-intensive US university, the data indicated that the three leading East Asian universities virtually have almost caught up with the US research-intensive university for their competence in the preparation and development of doctoral students.

Challenges for doctoral training

Doctoral training programs globally have been experiencing changes driven by the growing social demands for knowledge society and lead to a type of identity crisis for doctoral education between training for scholars on the one hand and training for professional jobs on the other. Other contributing factors pushing a rethink of doctoral education include the declining market value for doctoral degree holders, the narrow training scope and the low quality of doctoral training, and the decline in funding for doctoral students.

Identity crisis: training scholars versus professional workers

Doctoral education requires a paradigm shift from training of the next generation of professors to the training professional workers for the knowledge society. University professors in doctoral programs have become resistant to change their views of doctoral education (Austin 2002; Cassuto 2015). This has led to debates between faculty members on the purpose of doctoral education. In addition, doctoral education differs by disciplines. For example, professors in engineering are more open to the changes than their colleagues in the humanities.

Doctoral students have differing motivations for undertaking doctoral studies (e.g., Litalien et al. 2015). Some students enroll in order to be an academic while the others have no wish to work as an academic. In the US, over 80% of doctoral graduates want an academic job in non-STEM fields while only 15% do so in engineering and 29% in the physical sciences (US National Science Foundation 2017). In the doctoral student survey, only 30% planned to work in academia. Because so many report wanting to work in other than an academic/research organization, the perceptional gaps between doctoral students and professors are widening. The programs are more aligned to being a scholar/researcher despite students' planning to work in a different field. This could lead to conflicts between professors and students and may lead to complaints to the university from external stakeholders.

Universities in East Asia are slowly waking up to the idea that there has to be multiple education to work pathways for the doctoral students they train. However, there are signs of changes of doctoral training in these countries. For example, Japan and Korea launched professional schools in the 2000s to emphasize professional training. Singapore's Nanyang Technological University has recently partnered Netherland's Wageningen University to develop a PhD program in food science and technology (China Weekly News 24 May 2016). Hong Kong and Singapore universities business school doctoral programs have leveraged on

their cities' strong financial hub status by training students for their respective finance industries. Most significantly for Singapore, the Committee on University Pathways beyond 2015 has looked to Finland and Germanys' Applied Sciences Model to advocate an industry-focused practice-oriented education (Singapore Ministry of Education 2017). While this is an undergraduate based model, there may be an accompanying doctoral education emphasis.

Generally, however, professors in East Asia are yet to be prepared for the new environment. Although entrepreneurial activities and socially oriented research are highly encouraged by national and institutional policies, less than 50% of the academics are involved in commercially or socially oriented research, according to the CAP data (Teichler et al. 2013). This suggests that academics are not focused on preparing their doctoral students for jobs in the professional fields. Although universities provide some professional programs to match societal demands, the majority of academics tends to be lagging in understanding professional practices. The ongoing question is whether universities should focus more on professional training than they do.

Declining market values

The economic value of a doctoral degree has declined as the number of graduates has increased (Smaglik 2014). This phenomenon is not only limited to doctoral education. With rapid growth of higher education, the value of an academic degree (bachelor, master) has also declined. Looking at degree holders over age of 25, 2.9% holds a doctoral degree in Switzerland followed by 1.7% in the USA, and 1.3% in Australia according to 2015 OECD data (2017). Nevertheless, a doctoral degree still has significant employment value and future earning power. Masters or doctoral degree holders earned 177% of annual income compared with those who only completed upper secondary education, while it is 152% for bachelor degree holders in Germany in 2014. The relative earning differences are represented in Fig. 4. In addition, doctoral degree holders have an employment rate of 94% which is 6% higher than bachelor degree holders. Clearly, a doctoral degree has a higher economic value than a bachelor or master degree.

Nevertheless, the number of doctoral students is unpredictive of the future value of the doctoral degree. Enrollment has stabilized or is declining in some countries. For example, enrollment has been continuously declining in Japan and Taiwan since 2010 (Arimoto 2018; Chen 2018). This is closely related to the job market for doctoral degree holders. It takes much longer for doctoral graduates to find a stable job after graduation (e.g., Kehm 2006; Polka 2014), and many hired on fixed-term contracts which means that they end up working in unstable positions (e.g., Gould 2015). There is good reason to predict that the economic value of a doctoral degree will continue to decline. However, there are many positive signs from outside of the academic job market. In the age of global and technological acceleration, doctoral students are finding a variety of professional opportunities that draw upon the knowledge and skills they learned as doctoral students. For example, 48.5% of the US doctoral degree holders found their jobs in academia, 32.4% in industry, and 7.51% in government among the 2015 doctoral degree recipients in the US National Science Foundation (2017). In addition, German doctoral degree holders employed in outside of academia earns one-third higher annual incomes compared to their peers in academia in among German doctoral degree holders, according to Flöther (2015).

The market value for doctoral degrees differs across disciplines. For example, the market value for engineering doctorates is unlikely to decline. According to the US National

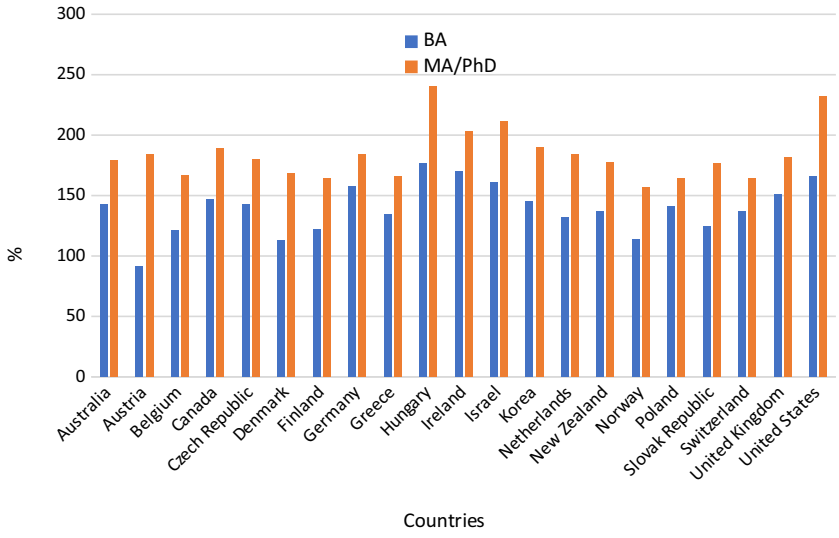

Fig. 4 Earning of MA/doctoral graduates in comparison with upper secondary education. *Data source* OCED Relative Earning data (2015). Relative earning of upper secondary education is "100"

Science Foundation (2017), doctoral degree holders in mathematics and computer sciences earn double the salary of their peers in the humanities, while doctorates in physical sciences earn 1.6 times, and in psychology and social sciences they earn 1.4 times higher salary. Although we may agree that doctoral study is undertaken not just for monetary purposes, the increasing gap in market value between disciplines may lead to difficulties in attracting the best qualified doctoral students to some disciplines, especially the humanities and social sciences. The market value of doctoral degrees will continue to be a serious issue in a discipline that does not provide good job opportunity or promise strong economic returns.

Discipline-based training with a narrow scope

Although social demand for doctoral training has changed, professors prefer to train their doctoral students according to their own disciplinary knowledge and skills (Austin 2002). For those who will build a career outside of the university after graduation, a multidisciplinary and real world orientation toward finding solutions to practical problems is more valuable than a singular disciplinary approach (e.g. Barnett 2004; OECD 2012). This is not a serious limitation while training future scholars and researchers, but it is when doctoral education moves to an emphasis on the preparation of professionals who will not become university scholars or scientists (e.g., Green 2009). Therefore, one challenge for doctoral education is to minimize the shortfalls of the narrow scope of disciplinary knowledge.

State and institutional policy encourages the lessening of disciplinary barriers through opening multi-disciplinary programs, joint appointments of professor between different disciplines, joint doctoral programs, etc. (e.g., Austin 2010; Willettes et al. 2012). In addition, some countries have developed new types of programs to grant degrees based on practice, e.g., PhD by publication (rather than dissertation), practice-based doctorate (performing arts), professional doctors, are examples of experimentations (e.g., Barbara et al. 2018; Bentley and Meek 2018; Usher 2002). Switzerland is experimenting with developing a practice-oriented doctoral program between the university sector and applied sciences (Baschung 2018). These new initiatives may weaken the discipline-specific doctoral education and contribute to a wider scope for doctoral students, despite the reluctance of universities and professors to embrace this.

The challenge is how to train doctoral students with broader views based on disciplinary knowledge and skills if the university (or professors) does not want to move away from being based on the disciplines. In academia, building interdisciplinary knowledge is not possible without disciplinary knowledge and skills. The specialization in a discipline is a fountain of knowledge and technological progress in the modern university. One could propose team teaching, multidisciplinary academic units, joint degrees, and many other hybrid forms of teaching and research. However, there are few success stories as yet in East Asia that can be cited. That will surely change.

Quality of doctoral training

Unlike the US, Quality assurance was not much of an issue in European doctoral training because the training was not a part of their 'education' system. Quality assurance frameworks are of little relevance in doctoral programs where coursework is not an integral part. One could argue that students can develop their disciplinary knowledge and skills through intensive supervision and active participation in research projects. However, according to the CAP data, many European and British systems do not provide intensive supervision or the opportunity for research project participation (Teichler et al. 2013). This implies that most doctoral students prepare their dissertation through self-study and develop their competence without intensive mentoring from their professors because in the European and British tradition they consider doctoral students as researchers rather than students. However, it is a serious challenge to these doctoral training systems if we include doctoral education as a part of education systems.

Academic and policy discourses on quality assurance have focused on bachelor education with the framework now being applied to master's education. For example, the UNESCO Bangkok Office is initiating to develop qualification criteria for a master's program in the region under UNESCO's Education 2030 (UNESCO Bangkok Office 2017). This discussion might be expanded to encompass doctoral education in the near future. A growing number of European universities have developed coursework systems under the Bologna Process (Kehm 2004). In addition, academic researchers and policymakers have begun to research doctoral education. Jones (2013) found that journal articles on doctoral education have begun to proliferate in the period 1971–2012. These policy and academic research interests might lead to the development of frameworks for quality assurance for doctoral education. In the professional society and professional training, the future standardization of doctoral degree qualifications must be faced (e.g., Nerad 2010). In this regard, the European and British systems will face more challenges than the US systems.

The various systems have developed their own way of assuring the quality of doctoral programs (e.g., Andres et al. 2015). In her observation of European doctoral education, Kehm (2006) concluded that the State indirectly regulates doctoral programs in the UK, the Netherlands, and Nordic countries while directly controlling it in Central and Eastern European countries. Quality assurance for doctoral programs

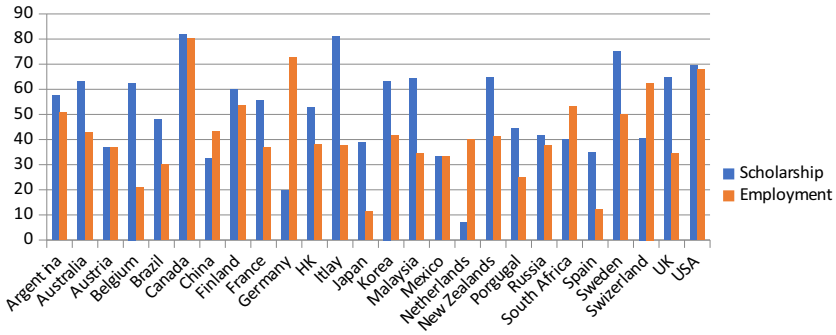

Fig. 5 Financial supports for doctoral students: scholarship versus employment opportunity. *Data source* The Changing Academic Profession 2007/2008

has been established in many of the North American systems. Although there are differences, we predict that the other systems will be influenced by the North American systems and practices as they were for bachelor and master programs. The quality assurance frameworks are already established in some East Asian systems as well as other continents as a part of academic program evaluation (e.g., Bentley and Meek 2018).

Funding for doctoral students

Doctoral students spend a minimum of 3 or more years on their doctoral degree, paying expensive living costs and tuitions in some countries. It is not easy for doctoral students to study without extensive funding support. Unfortunately, funding support for doctoral students is declining and tuition increasing in many countries because of reduced public funding for universities. The funding issue is becoming more serious in the Anglo-American systems where the market principle is widely applied in the higher education sector. Doctoral students, especially foreign doctoral students are considered a major revenue sources. There is little available data on the funding support for doctoral students although the CAP data provide some insights as shown in Fig. 5.

There are different types of funding for doctoral students. One is scholarships and fellowships; the other is proving employment opportunities during doctoral studies. Although each system combines both types, there are subtle differences between systems. For example, Germany, Netherlands, Switzerland, China, and South Africa rely more on employment opportunities, whereas Italy, Sweden, Belgium, UK, Netherlands, Japan, Korea, Malaysia, and Brazil rely on scholarships or fellowships. However, it is not easy to determine whether the funding is enough for doctoral students to cover their living costs and tuition. Some students have both a scholarship and employment opportunity while others have neither. The funding data imply that funding mechanisms vary, depending on national and institutional contexts even within the same region.

In addition, funding differs across disciplines. According to the US National Science Foundation (2017), doctoral students are funded by teaching assistantships (TA) primarily in the humanities, by research assistantships (RA) in engineering and physical sciences, by fellowships and grants in life sciences, and through their own income and/or employer paying the costs in the education fields. Funding was not considered a serious issue for doctoral students because policy makers believe strongly in the user pay approach to doctoral education. However, it is becoming a policy issue with the growing numbers of enrollments and resolution may require loan systems, but funding remains an obstacle for potential doctoral students especially from low socio-economic status.

Conclusions

Doctoral training is still largely under researched compared to other areas of research in higher education. However, this is beginning to change and policy makers are aware that Asia's research universities will be experiencing a rapid rise in the quantity of doctoral programs due to the massification of undergraduate education. More importantly, there is a consensus that the quality of doctoral education must be improved. If that happens, it will improve the balance of international trade in doctoral education, as indicated by excellence initiatives and willingness to attract more overseas students into doctoral programs. Reforming doctoral education has become an essential objective of Asian excellence initiatives to build world-class universities. The changing environment of doctoral education is already apparent as noted in the trend data provided in this article. Such data is a basis for further empirical research on doctoral education in Asian universities.

Doctoral education is relatively less systematic and standardized compared to K-12 and other tertiary forms of education. The gaps between the developed and the developing systems will begin to decrease and the latter have the opportunity to learn from the mature systems in the West. The East Asian universities have made enormous strides in global rankings. They have a promising future if these universities aggressively invest resources and upgrade

their systems. As some studies (e.g., Shin et al. 2014) have found, the research performance of the domestically trained doctoral degree holders in the region is not lacking in productivity compared with the doctoral degree holders from abroad. The rapid growth of doctoral training in the region has been helped by those graduates who returned from doctoral study at foreign universities as well as the increasing number of internationally mobile academics. However, close links between knowledge production and social development might not be possible without locally established doctoral training.

A critical issue for doctoral training is how to equip talent with locally relevant content. The world-class university discourses tend to emphasize global competitiveness and focus less on locally relevant issues. The foreign university-trained academics might have contributed to the East Asian universities in the race for publications. However, a major challenge remains in finding better ways to reform doctoral education so that there is a closer link between the knowledge that we produce and local social and economic development. An international project entitled Academic Professions in the Knowledge Society is designed to focus on this challenging issue. The project of this study *Doctoral Students in East Asian Flagship Universities* is designed to empirically support policy and institutional initiatives for reforming doctoral training in the region. However, we believe that the project also has implications to other systems, such as European universities where standardized doctoral training is not yet in place.

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