A Retrospect View from PhD training in Taiwan

Chen, Robin Jung-Cheng

Associate Professor, National Cheng-Chi University

Ho, Sophia Shi-Huei

Associate Professor, University of Taipei

Peng, Yao-Ping

Assistant Professor, Hsuan Chuang University

1. Introduction

The rise of a new model of society- increasing democratization and human rights, socialization, and the advent of development planning-advanced higher education institutions (HEIs) into a rapid expansion, becoming an inevitable phenomenon in a worldwide sense (Bryson, 2004; Marginson, 2016; Mok & Neubauer, 2016; Schofer & Meyer, 2005). For example, Taiwan, with no exception, has undergone the massive expansion with the past three decades (Chang, Nyeu, & Chang, 2015). According to the results yielded from the government in Taiwan demonstrated that in total of 784 programs has been established including 379 undergraduate programs, 302 master programs and 103 PhD programs (Ministry of Education, 2015). In addition, the explosively growth in student numbers- an 18-time increase in master's degree and a 20-time increase in doctoral students- also suggests its inflation in HEIs.

This prosperous development of HEIs can be attributed to the change of social structure, from industrial to postindustrial society, which lead the further division of labor and the changes of Taiwan human resource structure that have great influence on the supply and demand of human capital. On the other hand, the rapid expansion of higher education can be referred to the serial educational reforms in Taiwan's post-authoritarian era, especially since the 1990s (Ministry of Education, 2013a). In terms of both rapidly growing number in universities and size of the student population, Taiwan's higher educational policy has been shifted to once mainstream of elite education to one striving for universal education, according to Trow's (1974) classification of the higher education system.

Since 1994, teacher education programs in HEIs were extensively launched, making the demand of HEIs for doctoral mentors unabated and an urgent call for more matriculation of doctoral students. In particular, a number of elementary and secondary school teachers have chosen to pursue further study in HEIs, paving the way for hyper-expansion of doctoral students from elementary and secondary school teachers, evidenced by Ministry of Education. (2015), indicating that a significant growing number of universities from 1984 to 2014 escalated the enrolments of doctoral students, in a total of 30,549 in comparison with 1,500 in 1984

Due to the low birthrate, however, the need for teachers of K-12 education in

Taiwan has sharply decreased in recent years, resulting in 44 teacher education programs being withdrawn from HEIs within 5 years (Ministry of Education, 2013b). The withdrawal has outstripped the balance of supply and demand, ending up the faculty members unemployed or dislocated to other professions. Moreover, excessive PhD graduates and the downsizing academic positions have jointly engendered the disproportion between the supply and demand of doctors in labor market. For example, an investigations conducted by Ministry of Science and Technology (2016), the unemployment rate among doctors has been up to 3.1%, reaching its peak over decades. The situation was unrelentingly aggravated when the government responded to the intensified competitiveness in globalized world. The indexes and measurements were adopted to evaluate the performance of higher education in order to take higher ranks in global league tables (Deem, Mok, & Lucas, 2008; Mok, 2000; Mok & Chan, 2008), leading a new the policy and strategy implemented by the government and HEIs which aimed to pursue the quantity of publications regardless of if the training quality is rigid or germane to the doctoral students or where the PhD should be accommodated after graduation.

The considerable insecurity created by casualised employment have also perished their motivation in pursuit of doctoral degree (Bryson, 2004). Although the declining number seemly can mollify the unemployment rate amid doctoral graduates, much attention should be paid to the importance of maintaining an adequate supply of quality manpower in the knowledge-based economy era. Numerous schemes and policy were proposed to provide the solution including the promotion of the international mobility for doctoral students, the international employment and enhancing the competitiveness of domestic doctors, but the current official and civil results are still being deemed as inadequate.

The discrepancies can be ascribed to various aspects. The intent of this paper is to take a retrospect view by examining issues associated with HEIs in Taiwan. A number of topics are addressed including the doctoral preparation, the orientation of higher education policies and the situation of imbalanced doctor graduates demand and supply in Taiwan. Also the historical context and development of the doctoral program are introduced to illustrate the background of the rapid growth amid doctoral students and the current challenges to draw a holistic conclusion.

2. The historical background of developing PhD program in Taiwan

The research doctorate, usually referred to as the Ph.D., is universally regarded as representing the ‘pinnacle of scholarship’, especially those hoping to pursue academic employment contribute their findings from publishes to the society (Gilbert, 2004 Maldonado, V., Wiggers, R., & Arnold, 2013). The development of Taiwan doctoral

program is closely related to the historical context of the overall higher education. Generally, the 1994 educational reform is an important watershed in the history of Taiwan doctoral program. Since 1986, high schools, colleges and universities were extensively established to provide people with accessibility to higher education. The reform rationale the rapid growth of doctoral students for the dramatically increasing demand for doctors to satiate the desire from those who were craving for the matriculation in HEIs. As shown in Table 1, the number of enrolment in doctoral students accrued since 1994. While the number of doctoral students reached its peak in 2010, the quantity began to decline since then.

Table 1 The number of doctoral students and graduates from 1991 to 2015

Year	the number of doctoral students	the number of doctoral graduates
1991	5,481	518
1992	6,560	608
1993	7,713	708
1994	8,395	808
1995	8,897	848
1996	9,365	1,053
1997	10,013	1,187
1998	10,845	1,282
1999	12,253	1,307
2000	13,822	1,455
2001	15,962	1,463
2002	18,705	1,501
2003	21,658	1,759
2004	24,409	1,964
2005	27,531	2,165
2006	29,839	2,614
2007	31,707	2,850
2008	32,891	3,140
2009	33,751	3,589
2010	34,178	3,705
2011	33,686	3,846
2012	32,731	3,861
2013	31,475	4,241
2014	30,549	4,048
2015	29,333	4,000

Source: Ministry of Education (2015).

2.1 Establishing period

Since 1961, the need for hi-tech human resources in order to boost economic growth encouraged private schooling, especially short-term junior college education, thus to realize the rapid expansion of higher education in a short period of time by virtue of private funds. In 1963, normal schools were even upgraded to normal specialized postsecondary colleges. As a result, a large number of technical colleges were established. From 1962 to 1966, 30 newly-built colleges were added, including 2 agricultural colleges, 6 teachers, colleges, 8 technological colleges, 5 business colleges, 1 industry and commerce college, 3 medical colleges, 2 management colleges, 1 nursing college, 1 housekeeping college and 1 language college. From 1967 to 1971, there were newly added 15 technological colleges, 1 marine college, 2 nursing colleges, 2 business colleges, 1 normal college and 1 enterprise college. After 1972, the expansion of higher education in Taiwan shifted from college to university level (Chen, 2015).

It is generally believed that the expansion of higher education occurred in 1986 and 1997. In the former, as Mok (2000) claimed that following the lifting of martial law and the eager to parallel to international universities, the government empower universities to run autonomously, being able to establish private-owned universities and approved to restructure junior colleges into colleges, which the number of universities and colleges started to skyrocket. As to1997, in order to increase accessibility to higher education, the government exponentially expanded universities of science and technology and the technical colleges (Chen, 2015; Huang, 2011; Shen, 1998). The decentralization from the government and concern for prosperous economic development are the stimulus to provide people with more accessibility to be enrolled in higher education

During this period, it is apparent that the policy to economic development and decentralization of the government can account for the accruing establishment of universities. However, there was still lack of diversity in field since technological skills had been regarded as the most influential catalyst to the national development. From 1962 to 1971, 23 technology colleges were established out of 52 in total.

2.2 expansion period

The expansion of the number of doctoral students can be ascribed to Teacher Education Act and Policy of Polybasic Teacher Cultivation which HEIs are approbated initiate teacher education programs that were only limited to HEIs governed and controlled by the government (Law, 1995; Ministry of Education, 2013b). The demand for more PhD pouring into HEIs to manage the growth of enrolments was accordingly

expanded. Therefore, doctoral programs in education field were widespread in order to satiate the thirst for professors. Chang and Shaw (2016) maintained that the number of doctoral students in 2013- 2634 in total and 328 doctoal students in education field- is an approximately tenfold increase in population in contrast to 1994- 286 and 34 respectively.

On the other hand, the expansion of higher education which can be attributed to theory of knowledge economy has spurred national government to invest in expansion of doctoral studies, hoping the flow of academic knowledge can be become a key element of national economic policy (Auriol, Schaaper, & Felix, 2012; Borrell-Dami, 2009; Cuthbert & Molla, 2015; Nerad, 2010; Servage, 2009). The statement corroborated by Lin's study (Lin, 2004), indicating that higher education did provide positive outcome in contributing economic development. Also, Nerad (2011) argued that the quality of doctoral students has become a vital element in university research because they are intensively involved in producing a significant amount of new knowledge and, more importantly, doctoral education produces future researchers. Therefore, substantial funds were allocated to develop master and doctoral programs. As statistics demonstrated, the rate of PhD in Asia, Europe and United States are all positively increased in the last two decades (Cyranoski, Gilbert, Ledford, Nayar & Yahia, 2011; Nerad, 2010).

By international comparison, Wang (2003) found that the significance of human resources to the economic development was the catalyst to advocate to expand the number of higher education, which leads the former elitism higher education to transfer to mass higher education as similar as Japan and United States by drawing the comparison with the age participation and the total population of Taiwan. Mok (2000) contended that the rapid social and economic changes goaded the government to unleash it bridle on the higher education system; therefore, well aware of paralleling to the competitiveness in regional and global markets, the government began to capitalize the investment on the expansion of higher education, engendering immense number of HEIs to flourish.

During the swelling phase, a critical policy-led change upgrade the number universities. Teacher education reform unleashed the centralization on the teacher education programs controlled by the government. Consequently, programs became accessibility directly increased the enrolments, making the shortage of faculty in HEIs at risk, and doctoral programs were hence extensively launched to fill the void. A shift from industrial period to the emergence of knowledge economy goaded the government to nurture more doctoral candidates in order that the competitiveness could be

comparable among nations.

2.3 Challenging period

The accelerating number of PhD holders did not drive the equivalent demand in labor market. The widespread HEIs, PhD programs in particular, in Taiwan makes diploma inflated in higher education and results in perceived devaluation of educational qualifications (Chen & Chin, 2016; Wang, 2003). Cuthbert and Molla (2015) asserted that excessive PhD recipients has been regarded as another dimension of the graduate problem, which is even exacerbated by the declining occupational demand. Indeed, as Maldonado, Wiggers, and Arnold (2013) argued, holding PhD degree as the pinnacle of scholar, who has deemed in pursuit of academic position in HEIs will not 'secure full-time academic positions'.

In addition to the disproportion between demand and supply, scholars argued that whether doctoral programs provide suitable curriculum and system to train PhDs with skills that meet the requirements of both the academic and the non-academic. Morrison, Rudd, and Nerad (2011) surveyed recent recipients of different disciplines and found that a better career training, particularly in transferable skills are much needed for doctoral recipients. Cuthbert and Molla (2015) also agreed that the lack of reforming curriculum to meet the requirements for the labor market cannot provide graduates with the skills to pursue a career in academic or non-academic. However, De Grande, De Boyser, Vandevelde, and Van Rossem (2014) found that even though graduates has confronted the expectation outside the academia with the anticipation of holding a range of skills and knowledge applied to the volatile environment, doctoral training remains aiming at a future academic career. The unpromising future for doctoral students reflect the number of enrolments- none of any doctoral student being enrolled in 36 doctoral programs among 19 HEIs in 2014 (Ministry of Education, 2015). The government has forestalled that the number of doctoral students will be reduced from 7,670 in 2003 to 4,800 in 2023, leading to an approximately 37% reduction (Ministry of Education, 2013a).

During the stage, it is found that imbalance between demand and supply has severely stricken the favorable career path for PhD holders. The limited vacancies in HEIs due to the low-birth rate has aggravated the employment for the skyrocketing enrolments in doctoral programs. Although the admission to the program is declining, seemly assuaging the excessive demand, the issue of curriculum reform has been raised in order that practice-oriented program may diversify the risk for the employment in the labor market.

3. Imbalanced supply-demand in academic labor market

Being appointed by HEIs as a professor has been the unanimous career path for PhD recipients (De Grande, De Boyser, Vandevelde, & Van Rossem , 2014; Nerad, Rudd, Morrison, and Homer, 2006). However, Maldonado, Wiggers, and Arnold (2013) claimed that a completion of doctoral degree does not guarantee a path to a 'lucrative end'. Although Auriol (2007) argued that even if the unemployment rate vacillates, it remains generally low among PhD recipients, Halse (2007) countered that numerous doctoral graduates comparing to limitedly available position in HEIs has prompted the questions of future employment for PhD. In fact, according to Barnes and Randall's (2012) research, 23,009 currently or formerly enrolled doctoral students (left without their degrees within 5 years) and recent graduates (within 5 years) from 5,000 doctoral programs were surveyed, finding students enrolled in research intensive universities especially in the field of social sciences and education, were less satisfied than expected with the guidance for academic careers.

On basis of the investigation, even if the enrolments are declining, there are only existing limited vacant positions in Taiwan HEIs for more than 30,000 doctoral students, coupled with approximately annual 4,000 graduates (Ministry of Education, 2016), explicitly indicating the severely problematic oversupply. The imbalance is hugely effected by the sluggish economy in Taiwan. The severely dragging economy has forced PhD holders to work in low-wage labor market, which is disproportionate to those high-skill talents who endeavored the efforts and spent the time on advancing the knowledge.

The aforementioned problem has been severely deteriorated by the low-birth rate in Taiwan. According to Chen's (2010) investigation, the number of children in 2001 was 260,354, dropping to 166,886 in 2010, listing Taiwan as one of the lowest birth rates in the world. In addition, it is speculated that the population's negative growth will begin to occur in 2022 On the other hand, according to Department of Household Registration, Ministry of the Interior (2011), the number in 2016 will have declined to 271,450 and the number will continue its path of decline to 166,866 in 2028. In accordance with the low-birth, five merges of universities and two withdrawals within five years have magnified the crisis, driving the uncertainty and dearth in labor market. Among PhD programs, admission to doctoral programs were also reduced to 70 % since 2015, coupled with the implementation of "Young Scholars Developing Plan" to limit the quantity of doctoral students (Ministry of Science and Technology, 2015). However, at some point, mergers have created 'centres of excellence'; renewed governance may create an influx of more funds to accelerate research outputs and gain the

competitiveness among the rankings prior to the reforms (OECD, 2009).

Chen and Chin (2016) asserted that although statistics conducted by (Ministry of Education, 2014) demonstrated that the university enrollment rate for applicants soared to over 100% in 2008 and in 2011, 163 HEIs had come into existence with 1,352,084 students and 3,326 affiliated graduate programs with 217,799 postgraduates enrolled, the inflation in higher education degrees was yielded by the expansion of university, placing higher education in a challenging situation. Questions are prompted by the phenomenon: whether the competitiveness has been this come in effect by widely expanding HEIs to make bachelor degree ubiquitous (Chen & Chin, 2016)? This question echoes the statement claimed by Shulman, Golde, Bueschel, and Garabedian (2006) that the increasing doctoral recipients and the lack of high quality in training have made the degree perceived as 'second-rate'.

The imbalance and inflation occurred to HEIs in Taiwan have raised the waves of reform. Sparse academic positions in HEIs as a faculty prompt the policymaker and the institutions to direct the doctoral programs as industry-oriented. However, as Johnsrud and Banaria (2004) articulated, there is existing controversy within doctoral programs about whether preparing doctoral graduates for meeting the employers' demands or in accordance with the essential purpose of being a scholar. What makes more ironical rests on that on account of lacking funds supported from the government and more scrutinizing on the productivity of publications, the doctoral students are not prepared for faculty employment either (Austin, 2002; Badley, 2009; Johnsrud & Banaria, 2004). On the other hand, facing the growth and expansion in HEIs, the organization and governance of academic institutions, compelling a shift from the major tendency of producing and transferring knowledge via conducting research to embed the elements of practice field into the doctoral programs in a bid to adjust major social and policy-led changes (Boud & Lee, 2009).

4. Schemes to the crisis of oversupplied PhD enrolments in Taiwan

Whether doctoral study should keep accord with 'stewards of the discipline' has been questioned (Boud & Lee, 2009). In the face of unprecedented changes of the demands from the academic standards, labor market, the government seeks to propose a range of plans to propitiate the illness embedded in the PhD programs. Borrell-Damian (2009) maintained that doctorate graduates play a pivotal role in transmitting solid background knowledge to foster innovation and technology. In other words, employment in academia should not merely confined to a doctoral graduate's career path. Further issues will be addressed via the lens of academic, industrial and academic-industrial approaches to examine how HEIs respond to the speedy changes in the work world.

4.1 Academic-oriented approach

Acquiring a professorial position in university has been a dominate motivation for PhD holders (Chang & Shaw, 2016; Maldonado, Wiggers, & Arnold, 2013). However, if the doctoral students are eligible enough to match the skills and knowledge demanded by the academia are questioned (Morrison, Rudd, & Nerad, 2011). The deficiency accentuates the urgency of dealing with the cap. In a bid to enhance the cooperation with international scholars, Ministry of Education launched "International Talent Cultivation Plan", activate the flow of interaction between domestic and international HEIs. Besides, several candidates will be designated and sponsored by the program to enhance the international mobility amid Taiwan doctoral students, hoping to hone their competency and quality of conducting research.

Further, Solimano (2008) claimed that mobility of talent is able to contributed to better economic development and professional opportunities than in the home country. The statement substantiated by Jonkers and Tijssen (2008), contending that a visibly upward trend has emerged as numerous governmental initiatives being implemented to actively encourage domestic researchers to be trained and educated to nurture the expertise in R&D and linkages with international institutions, which a significantly positive impact on the publication productivity in acmatic research institutions can be accordingly engendered. In basis of the benefit, the government launched the program called 'Swift Horse Program' to subsidize doctoral students to conduct research across frontiers (Ministry of Science and Technology, 2016). This diaspora policy aims at mobilizing the latent doctoral students to be located in foreign countries where institutionally organized networks can be connected and ideas and knowledge can be exchanged. Through the implementation of these programs, it is highly expected that

the ties between domestic research system and other the global science system can accordingly be strengthened.

There is a scholarship for overseas study has been funded by the government for more than one hundred years. The scholarship has allowed the eligible sponsored to apply either doctoral or master program. However, viewing doctoral graduates as the facilitator to national development, only doctoral programs are available to the funding recipients. Arguably, as echoing to the former statement, doctoral studies with most advanced forms of education and training available in modern societies are still perceived the most influential asset in the era of the "knowledge-based economy" (Borrell-Damian, 2009).

4.2 Industrial-oriented approach

Making PhD recipients employed in non-academic sectors has been received much attention and interest for policy-makers (De Grande, H., De Boyser, K., Vandevelde, & Van Rossem, 2014). However, scholars mentioned that obstacles existing for doctoral recipients in transition to industry to be imputed to less work experience, (Borrell-Damian et al, 2010), stereotypical views of doctorate holders as being isolated from the interaction with reality (De Grande, De Boyser, Vandevelde, & Van Rossem , 2014), less interested in industry for its priority remaining in an academic career (Nerad, Rudd, Morrison, and Homer, 2006) and the possession of competence for a PhD recipient being evaluated differently between academia and industry (Borrell-Damian et al, 2010).

At the other end of the spectrum, massification of PhD holders has crystalized the urgent problem in terms of whether the competency trained in doctoral programs can be seamlessly applied to outside academia. Boyser, Vandevelde, and Van Rossem (2014) argued that the oversupply in doctoral production is not commensurate with an equal increase in academic career opportunities at postdoctoral and faculty levels, turning the graduates to locate them in non-academic sectors for further career development. Cuthbert and Molla (2015) insisted that that broad employment options outside the academic sector will be considered as a crucial reform for doctoral programs. They claimed that transferrable and generic skills should be embedded in the curriculum so that the rate of unemployment may be thus lower than solely a factory of 'scholars'.

Although PhD has been viewed as 'pinnacle of scholarship', rationalizing the employment in HEIs to contribute to the advancement and diffusion of knowledge (Auriol, 2007; Gilbert, 2004 Maldonado, Wiggers, & Arnold, 2013), Maldonado,

Wiggers, and Arnold (2013) argued that the PhD programs should accommodate and respond rapidly to the changed labor markets. An empirical study conducted by Mendoza (2007) found that building partnership with industry can generate provide the doctoral program with funds to facilitate the research, make contributions to the society and more importantly, the interaction may pave the road for more job opportunities for the doctoral candidates. Echoing the changing structure, a private HEI, Shih Chien University, has launched "Innovative Industry Doctoral Program" to provide practical courses regarding the operation and management issues of the innovative business. On the other hand, National Chiao Tung University has established a PhD program under "Internet of Things Smart System Research Center" in a bid to cooperate with enterprise and construct the ample network with the industry. Except for HEIs, the government has endeavored to bridge the gap. 'In Service Training PhD Program' initiated by Taiwan Government targets at cultivating doctoral students' practice-oriented knowledge and skills, emphasizing the application of training in doctoral program being transferred to industry (Ministry of Education, 2016). From this standpoint, well aware of the urgency in doctoral programs

4.3 Academic-industrial approach

Borrell-Damian (2009) suggested that the research relationship between university and industry can be tracked back to 1800s. It represents the importance attached to these collaborations as important sources of knowledge and as a resource to conduct research. It is suggested that the attention has been paid to the policy maker whether the training and employment of doctorate holders can meet the expectations in non-academic sectors; the collaborative relationships between academia and industry has been prevailing among nations in Europe, America and Oceania (De Grande, De Boyser, Vandevelde, & Van Rossem, 2014; Thune 2009). The developing collaboration between university and industry has been assumed as means to inherently facilitate research and education than discipline-specific, independent research (Strengers, 2014). In Taiwan, Ministry of Education, since 2015 has begun launching industry-academy cooperation programs for cultivating research elites to apply the knowledge to the practice, providing the candidates two-year academic research and two-year practice in the industry. Apart from the program, Ministry of Science and Technology (2016) has also proposed a plan to encourage the interaction and cooperation between corporations and PhD programs as mutual benefits.

Jones and Grimshaw (2012) claimed that the university industry interface as a vital source of innovation to spurs a flow of internal resources and external partnerships, further explaining the schemes may significantly recognize the mutual benefits between industry and universities as a transmitter of skills, knowledge and expertise acquired in

the workplace which can also be applied to doctoral programs. Thune (2009) also argued that doctoral students indeed are a primary vessel of knowledge transfer between universities and firms, implicating that how knowledge is produced is not only confined to academic, but applicable to industry. A tangible map was proposed by Thune (2009) to provide variables deemed as the most important in literature, as shown in figure 1. It indicates that several concerns have to be considered if the university-industry program is adopted since varying disciplines or fields of research yield disparate cooperation with firms.

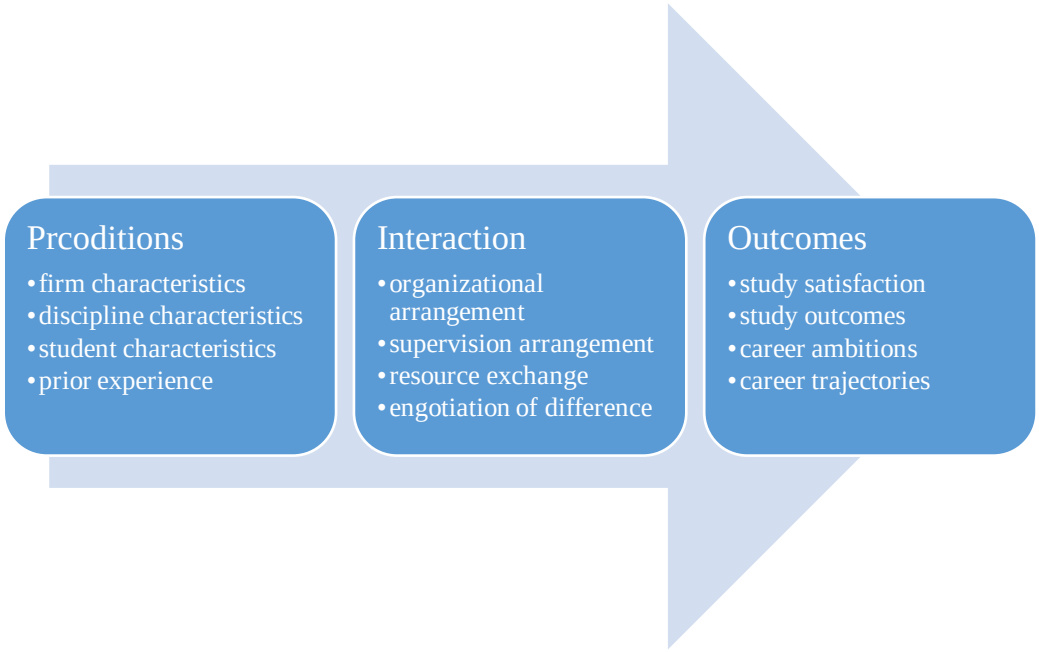

Fig. 1 Main variables investigated in research on doctoral students on the university–industry interface

Source: Thune, T. (2009). Doctoral students on the university–industry interface: A review of the literature. *Higher Education, 58* (5), 645.

However, it is worth mentioning that overemphasizing on the collaboration between university and industry may put pressure on the traditional-academic discourse. Furthermore, despite the partnership have also existed in Europe for decades (Borrell-Damian, 2009), a consideration should to taken in how to develop the collaboration in different settings. Indeed, the mobility from academia to practice has been limited partly due to the curriculum structure, training quality and mismatched skills. As De Grande, De Boyser, Vandevelde, and Van Rossem (2014) found, positioning in academia remains the priority for doctoral candidates' careers. Consequently, regardless of the benefits the collaborative relationship can be engendered and provided in relevance to the careers, whether the doctoral students are ready and if so, how the curriculum should be modified and designed can be a huge issue.

5. Doctoral Curriculum Reform

We hear that the training and/or education of doctoral candidates is in crisis (Kendall, 2002; p132)

Although several plans have been proposed as a panacea to the crisis in doctoral programs in Taiwan, the most fundamental concern has been expressed in respect to the form in doctoral curriculum. In China, Bai (2006) suggested that as the large-scale expansion surfaced in HEIs, the reform of the curriculum to increase graduates' flexibility and speciality has to be urgently implemented in response to market demand. As to western nations, it is also contended that the curriculum in HEIs should be continually improved to be conformed to the needs of the labor market even if the essence of doctoral curriculum is designed to aid students to build upon a disciplinary foundation, training them with more specialized depth of knowledge. (Holly, 2009; Özoglu, Gür, and Gümüs, 2016). Holly (2009) also added that while graduate students are confronted by an uncertain academic labor market, the graduate curriculum design remains aiming at linear path for the academic faculty career. Besides, critics argued that graduate students have been viewed as exploited asset as both students and employees under the culture that faculties relentless striving for funding to engage in research outputs, resulting in the graduate students who should be trained as students as a role of employee and faculties who should act as mentors and facilitators as a role of a project manager (Holly, 2009; Mend0za, 2007). Indeed, a question has been casted doubt on the employability a PhD holder regardless of in academia or industry market. A major reason behind this doubt rests on the high inflation in diploma and the qualifications now has been deemed relatively less valuable than they used to be.

In terms of academic training, however, research knowledge and skills are mostly gained from conducting research not directly instructed by coursework (Barnacle & Dall'Alba, 2011). Schwartz-Shea, (2003) also argued that the role as an advisory, in the apprentice model, may outweigh the significance of doctoral curriculum. From the standpoint of market driver, on the other hand, one of most important issues raised by Barnacle and Dall'Alba (2011) is 'the role of generic skills in the higher degrees by research curriculum'. Bai (2006) and Cranmer (2006) stressed that a curriculum must be designed with employability skills and diversity in a way that can function as the fulfillment of current and future needs and skills to center on economic and social issues. However, an examination of literature, due to its inimitable requirement and expectations for the doctoral students in each discipline, there are no existing criteria or unequivocal guideline in terms of how to reform doctoral curriculum although Kendall (2002) put that the view from interdisciplinary and globalization must be considered in

the doctoral training. On the wave of the wide spread of HEIs, Taiwan has confronted numerous issues in doctoral programs, especially how the curriculum should be adjusted and modified corresponding to the labor market. Besides, the prevalence of interdisciplinary in current age will challenge the traditional the structure and goal of traditional doctoral curriculum (Holly, 2009). Mitrany and Stokols (2005) found that several of the thesis have revealed the tendency to promote interdisciplinary research orientation among Ph.D. graduates. Hence, the combination of essential knowledge acquired from traditional coursework and interdisciplinary research training should be considered into the reform of doctoral curriculum. However, the concern has been less discussed in Taiwan. As the aforementioned in respect to the programs initiated to save the crisis, it is manifested that Taiwan has actively launched numerous approaches to reshape doctoral programs. Nonetheless, a gap needs to immediately bridged by designing a proper curriculum on basis of what the institutions would like to place the emphasis on, to facilitate the policy and rationalize the investment. While there is a unanimous agreement on the urgent reform of doctoral curriculum, a specific structure and design of training cannot be generalized and applied to each discipline since the purpose of every single doctoral program vary.

Another issue surfaces when it comes to the teaching duty as a faculty should be responsible for. Jepsen, Varhegyi, and Edwards (2012) have warned that lecturing experience may serve as crucial criteria for those pursue a career in academia; however, although full supports are rendered by mentors to PhD students to engage in lecturing, PhD students are more assigned to conduct research rather than pursue and enhance teaching skills. With this conflict, and under the model of apprentice, if there exists a need to design a curriculum for doctoral students according to the needs in labor market is concerned since within the apprentice relationship, mentors play a pivotal role in shaping PhD students' future career.

6. Conclusion

Multifarious issues have been laid out in this article. A historical retrospect was firstly taken to examine the development and process of HEIs and PhD programs in Taiwan. Varying setting had made policy vastly transform the climate of doctoral programs, putting the seemly positive accessibility to HEIs into a hazardous situation. In particular, the oversupply in doctoral programs was perceived as a burden in the labor market and as a pressure for PhD holders, doctoral students and policymaker.

In terms of resolving the crisis, we next propose how Taiwan government responded to the morass. In parallel to western nations, several approaches have been adopted. "International Talent Cultivation Plan" is launched to activate the mobility between domestic doctoral students and foreign research institutions, hoping to spark

the innovation and cooperation through the interaction. Engagement in industry is too accentuated in order to enhance the employability outside non-academia sectors. Some universities endeavored to indulge themselves in industries to cultivate doctoral students' practice-oriented knowledge and skills so that the application of training in doctoral program can be transferred to industry. Academic-industry approach places emphasis on the mutual benefits. Put differently, the funds granted by the industry may provide doctoral programs with sufficient resources to conduct research, which will in turn contributes to the development of the firms. It is emphasized that the mutual cooperation can give succor to the PhD recipients to grow both academic research competence and practical knowledge and skills.

Although these approaches seem promising and to some extent these 'prescriptions' are efficacious, potential risks are starting to emerge. Doctoral training has been criticized for not being able to meet the needs of employability in both academia and industry. The prevailing notion of interdisciplinary has signified the urgency to embedded it knowledge to doctoral training. On the other hand, lecturing experience is weighed as the one of the criteria as being employed a new faculty in academia, which is overly conceived as negligible training among mentors. With these concerns arising, it is imperative for policymakers to ameliorate the problems and further provide HEIs with a benign system for doctoral program to grow soundly.

References

Advance Collegiate Schools of Business. (2016). *The global salary survey.* Retrieved from http://www.aacsb.edu/~/media/AACSB/Publications/data-reports

Auriol, L. (2007). *Labour market characteristics and international mobility of doctorate holders: Results for seven countries*. STI Working paper 2007/2. Paris: OECD.Auriol, L., Schaaper, M., & Felix, B. (2012). *Mapping careers and mobility of doctorate holders: Draft guidelines, model questionnaire and indicators–third edition* (No. 2012/7). OECD Publishing.

Austin, A. E. (2003). Creating a bridge to the future: Preparing new faculty to face changing expectations in a shifting context. The Review of Higher Education, 26 (2), 119-144.

Bai, L. (2006). Graduate unemployment: Dilemmas and challenges in China's move to mass higher education. *The China Quarterly*, *185*, 128-144.

Barnacle, R., & Dall'Alba, G. (2011). Research degrees as professional education? *Studies in Higher Education, 36* (4), 459-470.

Barnes, B. J., & Randall, J. (2012). Doctoral student satisfaction: An examination of disciplinary, enrollment, and institutional differences. *Research in Higher Education,53* (1), 47-75.

Borrell-Damian, L. (2009). *Collaborative Doctoral education: University-industry partnerships for enhancing knowledge exchange*. DOC-CAREERS Project. Brussels: European University Association.

Borrell-Damian, L., Brown, T., Dearing, A., Font, J., Hagen, S., Metcalfe, J., & Smith, J. (2010). Collaborative doctoral education: University-industry partnerships for enhancing knowledge exchange. Higher Education Policy, 23 (4), 493-514.

Boud, D., & Lee, A. (2009). *Changing practices of doctoral education*. Oxford: Routledge.

Chang, C.W., & Shaw, W.C. (2016). Expanding higher education in Taiwan: The case of doctoral education. *Higher Education Studies, 6* (1), 1-14.

Chang, D. F., Nyeu, F. Y., & Chang, H. C. (2015). Balancing quality and quantity to build research universities in Taiwan. *Higher Education, 70* (2), 251-263.

Chao, S. Y. (2013). On wandering PhD graduates. *The Educator Monthly, 547*, 45-47. (in Chinese)

Chen, J. J. (2015). Institutional impacts and density dependence in Taiwan's higher education development. *Taiwan Journal of Sociology of Education, 58*, 1-45. (in Chinese)

Chen, R. J.& Chin, J.M. (2016). Beyond neoliberalism: Higher education diploma inflation in Taiwan. *KEDI Journal of Education Policy, 13* (1), 113-132.

Chen, R. J., & Chin, J. M. (2016). Beyond neo-liberalism: Higher education diploma inflation in Taiwan. *KEDI Journal of Educational Policy*, *13* (1), 113-132.

Cranmer, S. (2006). Enhancing graduate employability: Best intentions and mixed outcomes. *Studies in Higher Education*, *31* (2), 169-184.

Cuthbert, D., & Molla, T. (2015). PhD crisis discourse: A critical approach to the framing of the problem and some Australian 'solutions'. *Higher education*,*69* (1), 33-53.

Cyranoski, D., Gilbert, N., Ledford, H., Nayar, A., & Yahia, M. (2011). Education: The PhD factory. *Nature*, *472* (7343), 276-279.

De Grande, H., De Boyser, K., Vandevelde, K., & Van Rossem, R. (2014). From academia to industry: Are doctorate holders ready?. *Journal of the Knowledge Economy*, *5* (3), 538-561.

De Grande, H., De Boyser, K., Vandevelde, K., & Van Rossem, R. (2014). From academia to industry: are doctorate holders ready? Journal of the Knowledge Economy, 5 (3), 538-561.

Deem, R., Mok, K. H., & Lucas, L. (2008). Transforming higher education in whose image? Exploring the concept of the 'world-class' university in Europe and Asia. *Higher education policy*, *21* (1), 83-97.

Gilbert, R. (2004). A framework for evaluating the doctoral curriculum. *Assessment & Evaluation in Higher Education*, *29* (3), 299-309.

Halse, C. (2007). Is the doctorate in crisis? *Nagoya Journal of Studies in Higher Education*, *7*, 321–337

Holley, K. (2009). The challenge of an interdisciplinary curriculum: A cultural analysis of a doctoral-degree program in neuroscience. *Higher Education, 58* (2), 241-255.

Huang, I. C. (2011). *Educational tracking, strafication of labor market, and social status.* Taipei, Taiwan: Psychological Publishing. (in Chinese)

Jepsen, D. M., Varhegyi, M. M., & Edwards, D. (2012). Academics' attitudes towards PhD students' teaching: Preparing research higher degree students for an academic career. Journal of Higher Education Policy and Management, 34 (6), 629-645.

Johnsrud, L. K., & Banaria, J. S. (2004). Doctoral education: National issues with "local" relevance. *Educational Perspectives*, *37* (2), 20-27.

Jones, B., & Grimshaw, D. (2012). The effects of policies for training and skills on improving innovation capabilities in firms. *Compendium of Evidence on the Effectiveness of Innovation Policy Intervention. NESTA. Manchester, Manchester Institute of Innovation Research, University of Manchester, 38*.

Jonkers, K., & Tijssen, R. (2008). Chinese researchers returning home: Impacts of international mobility on research collaboration and scientific productivity. *Scientometrics, 77* (2), 309-333.

Kendall, G. (2002). The crisis in doctoral education: A sociological diagnosis. *Higher Education Research and Development*, *21* (2), 131-141.

Law, W. W. (1995). The role of the state in higher education reform: Mainland China and Taiwan. *Comparative Education Review, 39* (3), 322-355.

Li, S. S. (2010). Beware of the higher education mudflows: Evaluations and reflections on the higher education expansion policies in Taiwan. *School Administrators, 70*, 190-206. (in Chinese)

Lin, T. C. (2004). The role of higher education in economic development: an empirical study of Taiwan case. *Journal of Asian Economics*, *15* (2), 355-371.

Liu, H. F. (2014). Analysis on humanity PhD holders' employmentability. *Taiwan Educational Review Monthly, 3* (12), 16-22. (in Chinese)

Liu, X. X., & Huang, J. K. (2011). A study on higher education employmentability. *Journal of Educational Research and Development, 7* (3), 153-180. (in Chinese)

Maldonado, V., Wiggers, R., & Arnold, C. (2013). So you want to earn a PhD? The attraction, realities, and outcomes of pursuing a doctorate. *Higher Education Quality Council of Ontario*.

Marginson, S. (2016). The worldwide trend to high participation higher education: *Dynamics of social stratification in inclusive systems*. *Higher Education*, 1-22.

McAlpine, L., & Norton, J. (2006). Reframing our approach to doctoral programs: An integrative framework for action and research. *Higher Education Research & Development, 25* (1), 3-17.

Mendoza, P. (2007). Academic capitalism and doctoral student socialization: A case study. *The Journal of Higher Education, 78* (1), 71-96.

Ministry of Education (2013a). *Talent Cultivation White Paper*. Retrieved from http://ws.moe.edu.tw/001/Upload/3/RelFile/6315/6919/%E6%95%99%E8%82%B2%E9%83%A8%E4%BA%BA%E6%89%8D%E5%9F%B9%E8%82%B2%E7%99%BD%E7%9A%AE%E6%9B%B8.pdf (in Chinese)

Ministry of Education (2016). *International Talent Cultivation Plan.* Retrieved from http://www.edu.tw/News_Content.aspx?n=9E7AC85F1954DDA8&s=8406B014A930CBAB (in Chinese)

Ministry of Education. (2013b). *Innovative pedagogy and indivisualized gudiance.* Retrieved from http://www.k12ea.gov.tw/ap/tpdenews_view.aspx?sn= 9747b4e3-ef01-445a-8d99-0af331eeccf5 (in Chinese)

Ministry of Education. (2015). *General survey of higher education institutions.* Retrieved from http://depart.moe.edu.tw/ED4500/News_Content.aspx?n=48EBDB3B9D51F2B8&sms=F78B10654B1FDBB5&s=4396A90696381274 (in Chinese)

Ministry of Science and Technology (2015). *Plan for encouraging jounior faculty*. Retrieved from https://www.most.gov.tw/sci/ch/list?menu_id=a1d97073-2fd4 -4e81-8458-10cb3604ce8d (in Chinese)

Ministry of Science and Technology (2016). *Government subsidiaries for overseas studies*. Retrieved from http://statistics.most.gov.tw/was2/ (in Chinese)

Mitrany, M., & Stokols, D. (2005). Gauging the transdisciplinary qualities and outcomes of doctoral training programs. *Journal of Planning Education and*

Research, *24* (4), 437-449.

Mok, K. H. (2000). Reflecting globalization effects on local policy: Higher education reform in Taiwan. *Journal of Education Policy*, *15* (6), 637-660.

Mok, K. H., & Chan, Y. (2008). International benchmarking with the best universities: Policy and practice in mainland China and Taiwan. *Higher Education Policy*, *21* (4), 469-486.

Mok, K. H., & Neubauer, D. (2016). Higher education governance in crisis: a critical reflection on the massification of higher education, graduate employment and social mobility. *Journal of Education and Work*, *29* (1), 1-12.

Morrison, E., Rudd, E., & Nerad, M. (2011). Early careers of recent US social science PhDs. *Learning and Teaching*, *4* (2), 6-29.

Nerad, M. (2010). *Increase in PhD production and reform of doctoral education worldwide*. Research Institute for Higher Education Hiroshima University, 7, 769.

Nerad, M. (2011). What we know about the dramatic increase in PhD degrees and the reform of doctoral education worldwide: Implications for South *Africa.Perspectives in Education*, *29* (3), 1-12.

Nerad, M., Rudd, E., Morrison, E., & Homer, L. (2006). Confronting common assumptions: Designing future-oriented doctoral education. *Proceedings of Doctoral Education and the Faculty of the Future*, Cornell University, Ithaca, NY, October 8-9, 2006.

Organisation for Economic Co-operation and Development (2009). *Higher education to 2030: Volume 2: Globalisation*. OECD, Paris, France: The author.

Özoglu, M., Gür, B. S., & Gümüs, S. (2016). Rapid expansion of higher Eeducation in Turkey: The challenges of recently established public pniversities (2006-2013). *Higher Education Policy*, *29* (1), 21-39.

Schofer, E., & Meyer, J. W. (2005). The worldwide expansion of higher education in the twentieth century. *American sociological review*, *70* (6), 898-920.

Schwartz-Shea, P. (2003). Is this the curriculum we want? Doctoral requirements and offerings in methods and methodology. *Political Science and Politics*, *36* (03), 379-386.

Servage, L. (2009). Alternative and professional doctoral programs: What is driving the demand? Studies in Higher Education, 34 (7), 765-779.

Shen, S. S.. (1998). Book review on pedadogy of history. *Curriculum and Instruction, 1* (4), 127-132. (in Chinese)

Shulman, L. S., Golde, C. M., Bueschel, A. C., & Garabedian, K. J. (2006). Reclaiming education's doctorates: A critique and a proposal. Educational Researcher, 35 (3), 25-32.

Solimano, A. (2008). *The international mobility of talent: Types, causes, and development impact*. Oxford University Press on Demand.

Strengers, Y. A. A. (2014). Interdisciplinarity and industry collaboration in doctoral candidature: tensions within and between discourses. Studies in Higher Education, 39 (4), 546-559.

The Directorate General of Budget, Accounting and Statistics of Executive Yuan (2015). *Human resource report.* Retrieved from http://www.dgbas.gov.tw/ct.asp?xItem=18844&ctNode=4943 (in Chinese)

The Science & Technology Policy Research and Information Center (2016). *2015 Annual employment perception survey report of earned doctorates*. Retrieved from https://payment.narlabs.org.tw/stpibooks/tryout/books/000000005288579 90152a090857e14db/;jsessionid=8D5073860E457CD621D2AC5DF6199594?r= 20160222003608 (in Chinese)

Thune, T. (2009). Doctoral students on the university–industry interface: a review of the literature. *Higher Education, 58* (5), 637-651.

Trow, M. (1974). *Problems in the transition from elite to mass higher education.* Retrieved from http://files.eric.ed.gov/fulltext/ED091983.pdf

Wagner, C. S., & Leydesdorff, L. (2005). Network structure, self-organization, and the growth of international collaboration in science. *Research policy, 34* (10), 1608-1618.

Wang, R. J. (2003). *From elitism to mass higher education in Taiwan: The problems faced. Higher Education, 46* (3), 261-287.

Weidman, J. C., & Stein, E. L. (2003). Socialization of doctoral students to academic norms. Research in higher education, 44 (6), 641-656.

Wu, C. W. (2013). Don’t go for PhD! *NTU Alumni Bimonthly*, 89, 18-21. (in Chinese)