



Assessing Doctoral Students' Employability Skills

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Abstract

A significant number of STEM doctoral recipients are employed by industry. The goal of this study is to investigate PhD students' competency level at different skills and expertise they need to be successful at their jobs after graduating from university. This paper examines the results of a survey, based on Vitae Researcher Development Framework, of student perceptions of their skills and competencies in preparation for careers in industry, consulting, or government. The survey had four main domains including knowledge and intellectual abilities, personal effectiveness, research governance and organization, and engagement, influence and impact. In general, students mostly acknowledged the importance of majority of the items on each domain. However, they reported low competency levels on most of the skills. Students' self-reported low competency in the majority of the items raises concerns about their perceptions of their readiness to enter the job market.

Introduction

With the increase of doctoral graduates at universities, majority of graduates are employed by industry. However, graduate education fails to prepare students for careers outside of academia and graduate students are criticized for their lack of professional skills, such as teamwork, managerial, and leadership skills¹. In other words, although the majority of doctoral graduates are employed by industry, they are not prepared for professional workplace outside of academia. One solution that has been proposed by some researchers, educators, and industry administrators is offering systematic training and professional development to graduate students in order to prepare them for career options outside of academia².

To assess students' readiness of different skills that they need to be successful at their careers, we searched for a self-assessment tool to evaluate students' competency level. Surprisingly, most of the publications on necessary or employability skills for university graduates focus only on the undergraduate level^{3,4}. The few reports on doctoral graduates, only mention broad description of desired abilities without being specific⁵.

The framework that was the most suitable for this study was Vitae Researcher Development Framework⁶ (RDF), which was developed and well-studied in United Kingdom. This framework has four major domains, each with three sub-domains, and a number of items in each sub-domain. The four major domains are:

- Knowledge and intellectual abilities
- Personal effectiveness
- Research governance and organization
- Engagement, influence and impact

According to developers of the framework⁶, this framework:

“is a major new approach to researcher development, to enhance our capacity to build the UK workforce, develop world-class researchers and build our research base.

The RDF is a professional development framework for planning, promoting and supporting the personal, professional and career development of researchers in higher education. It articulates the knowledge, [behaviors] and attributes of successful researchers and encourages them to [realize] their potential”.

Research goal/questions

The goal of this study is to investigate PhD students’ competency level at different skills and expertise they need to be successful at their jobs after graduating from university by answering the following questions:

- To what extent do PhD students acknowledge the importance of necessary skills they need to be successful at their jobs?
- What is the self-reported competency level of PhD students’ skills that they need to be successful at their jobs?

Methods

Participants and settings

Fifty-six students who were enrolled in Preparing Future Professionals (PFP) course in Fall 2013 were invited to participate in this study. Forty-nine students participated in the study by completing at least one of the surveys. PFP is a two-credit hour course⁷, which utilizes a Pass/No Pass grading system. The goal of this course is to prepare graduate students for jobs outside of academia. In the PFP course, students engage in weekly two-hour mentoring sessions with industry professionals and recruiters, university alumni, faculty, and staff to discuss diverse professional environments including the skills, roles, and responsibilities required in the professional work place. Topics covered include leadership and management, financial education, project management, intrapersonal effectiveness, communication skills, career development, and career-life balance. During the semester students practiced assembling a professional portfolio, generating strategies for success in career advancement, networking with career professionals, developing a career strategic plan, and relating their career goals and skill sets to various institutional missions and values, company cultures, and expected job functions.

Administrating the surveys

Four surveys were created on Qualtrics based on the four domains of Vitae Researcher Development Framework (knowledge and intellectual abilities, personal effectiveness, research governance and organization, engagement, influence and impact). Each of these

domains is divided into three sub-domains. Number of items in each sub-domain varies between three to eight items (see tables 1 to 4). Participants had three weeks to complete the surveys. Each survey was divided into three main sections. For each item in the surveys, participants first rated the importance of that item based on a 4-point likert scale (not at all important, slightly important, important, very important). Then based on the description for each item, students rated their own competency level on a 5-point likert scale. To avoid survey fatigue, each domain was administrated in a different survey and participants were able to complete the surveys at different times.

Analyzing the results

Students' responses to survey questions were extracted and analyzed. To get a general sense of students' responses, for each question mean and standard deviation of responses were calculated and reported.

Results and Discussion

In this section the students' responses to the four surveys (i.e. four domains of Vitae framework) are reported.

Knowledge and intellectual abilities

Forty-nine students answered the questions in this domain (Table 1). Overall, students acknowledged the importance of the majority of the items. All items (except two, information literacy and management, and intellectual risk) rated more than 3 (out of 4) by students in importance. Students rated subject knowledge and analyzing the as most important items. Low standard deviations in importance scale also show students responses were close to each other. In other words, they consistently agreed that the items are important for their professional life.

Unlike the high averages in importance scale, the competency level of students was low. All averages (except Research methods- theoretical knowledge) were below 3 (out of 5). Students had the lowest competency in intellectual risks. In addition, the standard deviations for competency items were higher (sometime twice as the standard deviation of the importance scale) indicating variation in students' competency level.

Personal effectiveness

Forty-four students responded to the personal effectiveness survey questions (Table 2). Similar to knowledge and intellectual abilities survey, students believed the items of personal effectiveness are very important; all items rated more than 3 out of 4 on the importance scale. Time management was the most important item in this survey. Surprisingly, commitment to research was the least important item. Standard deviations for importance of the items were low, indicating students generally agreed on the importance of the items.

Table 1 – Summary of students’ responses to knowledge and intellectual abilities. High and low means in each scale are highlighted.

	Item	Importance (4-point scale)		Competency (5-point scale)	
		Mean	Std. Dev.	Mean	Std. Dev.
Knowledge base	Subject knowledge	3.57	0.58	2.94	1.01
	Research methods – theoretical knowledge	3.37	0.60	3.31	1.08
	Research methods – practical application	3.45	0.54	2.88	1.33
	Information seeking	3.47	0.62	2.53	1.23
	Information literacy and management	2.94	0.66	2.43	1.24
	Languages	3.14	0.76	2.35	1.11
	Academic literacy and numeracy	3.14	0.76	2.22	1.14
Cognitive abilities	Analyzing	3.57	0.58	2.69	1.14
	Synthesizing	3.31	0.58	2.42	1.14
	Critical thinking	3.49	0.62	2.57	1.06
	Evaluating	3.16	0.62	2.33	1.14
	Problem solving	3.55	0.65	2.90	1.18
Creativity	Inquiring mind	3.39	0.64	2.59	1.08
	Intellectual insight	3.33	0.69	2.65	0.97
	Innovation	3.29	0.61	2.29	0.98
	Argument construction	3.16	0.72	2.14	1.12
	Intellectual risk	2.98	0.72	2.08	1.08

Table 2 – Summary of students’ responses in personal effectiveness. High and low means in each scale are highlighted.

	Item	Importance (4-point scale)		Competency (5-point scale)	
		Mean	Std. Dev.	Mean	Std. Dev.
Personal qualities	Enthusiasm	3.39	0.54	2.66	1.03
	Perseverance	3.50	0.55	2.98	1.27
	Integrity	3.55	0.63	2.86	1.09
	Self-confidence	3.43	0.66	2.61	1.08
	Self-reflection	3.30	0.70	2.61	1.10
	Responsibility	3.50	0.66	2.59	0.95
Self management	Preparation and prioritization	3.30	0.59	2.82	1.04
	Commitment to research	3.18	0.58	2.57	1.13
	Time management	3.52	0.63	2.73	1.15
	Responsiveness to change	3.23	0.68	2.70	1.11
	Work-life balance	3.30	0.70	2.36	1.26
Professional and career development	Career management	3.59	0.58	2.14	1.07
	Continuing professional development	3.32	0.64	2.23	1.20
	Responsiveness to opportunities	3.36	0.72	2.16	1.14
	Networking	3.48	0.66	2.02	0.98
	Reputation and esteem	3.30	0.67	1.86	1.00

Students' competency level on personal effectiveness was similar to knowledge and intellectual abilities. All items on average rated below 3 (out of 5) indicating low competency level by students. Reputation and esteem was the lowest rated item in the personal effectiveness. Furthermore, the standard deviations in competency scale were higher than the importance scale, showing variability in students' competency level in personal effectiveness.

Research governance and organization

Forty-three students responded to the research governance and organization survey (Table 3). In general, students rated items in this survey important. All items were rated more than 3 (out of 4). From students' perspective, ethics, principles and sustainability was the most important item. All standard deviations were below one, indicating students consistently thought the items are important.

Competency level of students in research governance and organization was lower than the previous domains. Surprisingly, students' competency level for most of the items was around 2 (out of 5) or below it indicating the lowest competency level among all four domains. Research strategy was the lowest item among others. This finding is particularly surprising since students spend a great deal of their PhD time conducting research. Standard deviations were mostly more than one, indicating variations in students' competency level.

Table 3 – Summary of students' responses in research governance and organization. High and low means in each scale are highlighted.

Item	Importance (4-point scale)		Competency (5-point scale)		
	Mean	Std. Dev.	Mean	Std. Dev.	
Professional conduct	Health and safety	3.30	0.83	2.12	1.10
	Ethics, principles and sustainability	3.40	0.62	2.12	1.00
	Legal requirements	3.23	0.81	1.88	1.05
	IPR and copyright	3.14	0.77	1.91	1.02
	Respect and confidentiality	3.37	0.69	1.98	1.03
	Attribution and co-authorship	3.26	0.66	1.93	0.94
	Appropriate practice	3.19	0.66	1.98	1.01
Research management	Research strategy	3.09	0.68	1.67	0.94
	Project planning and delivery	3.30	0.64	2.14	1.19
	Risk management	3.02	0.71	1.91	1.02
Finance, funding and resources	Income and funding generation	3.28	0.73	1.72	1.08
	Financial management	3.19	0.66	1.74	1.22
	Infrastructure and resources	3.12	0.76	1.77	1.11

Engagement, influence and impact

Forty-three students responded to the engagement, influence, and impact survey (Table 4). Similar to the previous three surveys, students rated the items in this survey mostly important. All items (except policy) were rated more than 3 (out of 4). From students' perspectives, team working was the most important item in this domain. Low standard deviations indicate the students were mostly agreed on the importance of the items in this survey.

Students' competency level in engagement, influence and impact were generally low. All items were rated below 3 and some even below 2 (out of 5). Students had the lowest competency in public engagement. Standard deviations in competency were relatively more than the importance scale, showing variations in students' competency level in this domain.

Table 4 – Summary of students' responses in engagement, influence and impact. High and low means in each scale are highlighted.

Item	Importance (4-point scale)		Competency (5-point scale)		
	Mean	Std. Dev.	Mean	Std. Dev.	
Working with others	Collegiality	3.30	0.60	2.56	0.88
	Team working	3.58	0.54	2.56	0.98
	People management	3.26	0.66	2.30	1.23
	Supervision	3.05	0.79	2.28	1.24
	Mentoring	3.16	0.69	2.37	1.16
	Influence and leadership	3.30	0.67	2.21	1.08
	Collaboration	3.37	0.62	2.16	1.13
	Equality and diversity	3.28	0.80	2.47	0.98
Communication and dissemination	Communication methods	3.63	0.54	2.21	0.97
	Communication media	3.14	0.71	2.09	0.89
	Publication	3.42	0.59	2.12	0.97
Engagement and impact	Teaching	3.02	0.67	1.79	0.97
	Public engagement	3.12	0.73	1.74	1.14
	Enterprise	3.02	0.83	1.88	1.12
	Policy	2.77	0.84	1.95	1.15
	Society and culture	3.07	0.74	2.16	1.11
	Global citizenship	3.14	0.80	2.16	1.15

Conclusion

In this paper, we reported the importance of different skills and expertise from students' perspective as well as students' competency level at the end of the semester. In general, students mostly acknowledged the importance of the majority of the items. However, they reported low competency levels in most cases. Students' low competency in the majority of the items raises concerns about readiness of PhD Students to enter the job

market. One solution can be adding more explicit lesson plans, professional development lectures, and workshops to PhD students' plan of study to address these shortcomings.

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