

Managing Emergent Knowledge: Addressing the Competency Expectations of Biomedical Employers

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Abstract

Biomedical graduate students face an uncertain job market. A significant number of these graduates are sub or un-employed and work in areas not requiring a university degree. For those graduates experiencing this, feeling they have no control over their careers, future sub-employment has become a significant contributor to the rise in mental illness among this cohort (Frank & Hou, 2018). The government of Alberta has begun to communicate expectations that university education and training should be tied to labor market expectations, so this study surveyed and interviewed 92 biomedical hiring managers in western Canada. When asked which non-technical skills they felt graduate degree holders typically are missing, 85 percent of respondents indicated that project management and/or customer engagement were the skills that were lacking in recent graduate students in this field of study. The responses received from these leaders in the Biomedical field who were surveyed suggest that a skills awareness gap is preventing employers from understanding the full value of graduates because these graduates do not articulate the professional skills that they gain in graduate school

throughout the hiring process or demonstrate their competencies in the workplace. Accordingly, these shortfalls can be addressed by introducing project management and knowledge translation awareness into curricula. Demand for project management expertise is rising in the biomedical field. Greater awareness and exposure to project management and customer engagement through knowledge translation will help prepare students for the transition into their professional field of work, while also making them more productive in their educational program. Likewise, stakeholder (i.e., customers) interaction such as students presenting their research to stakeholders can promote knowledge translation while introducing students to potential employers earlier in their training.

Academic leaders receive significant pressure from employers to better equip students with the knowledge and skills to succeed in their careers (Bok, 2017) in addition to their academic program knowledge. Employers give students low grades in a variety of learning outcomes, including those considered most important for career success (Hart Research Association, 2015). Similarly, recent graduates have also indi-

cated that “unpreparedness” was a real problem (Bentley University, 2014) (Moore & Morton, 2017), suggesting that a “skills gap” exists between institutions and the workplace.

Science graduates face an uncertain job market in Canada, of the employment that graduates with a master’s degree in biology or biomedical sciences pursued, only 40% of these graduates obtained a job related to their field of study (Statistics Canada, 2018). Graduates with a doctoral degree in biology or biomedical sciences fared slightly better, with 55% of them obtaining a job related to their field of study.

Recently, it has been argued by media that the skills gap is actually a skills “awareness” gap because employers do not comprehend the professional skills students acquire through their training and co-curricular activities (Craig & Markowitz, 2017). Students contribute to the discrepancies by not being able to articulate their skills readily (Craig & Markowitz, 2017). Hence, universities need to develop and promote systems that help students to recognize their skills, competencies and achievements gained, developed and enhanced through their academic programs, work experiences and volunteer experienc-

es and how to communicate these underlying skills to employers.

To understand how we could prepare graduate students' transitioning to the non-academic workplace, email questionnaires and semi-structured telephone interviews were used to collect data from senior employees in biomedical companies, support organizations, and governmental organizations in western Canada. The goal was to determine the skills/competencies that employers valued in graduates from biology and biomedical graduate degree programs and the skills/competencies that recent graduates were missing. We contacted interviewees with human resource (HR) experience in biomedical companies, as well as interviewees that had previously hired employees with a graduate degree or represented organizations that hired employees with a graduate degree in biomedical science.

Methods

Two methods were used to reach the interviewees, direct email and through posting on Rainforest Alberta's Slack channel, a community involved in Alberta's innovation ecosystem. Interviewees were selected based on two criteria: 1) they had to be operating in the biomedical field, and 2) they had to have previously hired an employee with a biomedical based graduate degree. Criteria were verified using LinkedIn profiles. Each recipient was asked the following four questions:

- 1) Is there a non-technical skill that you typically see employees with a graduate degree excel at?
- 2) Is there a non-technical skill that you typically see employees with a graduate degree struggle with?
- 3) What skill do you think correlates most to the success an employee has in their role in your organization?
- 4) What have you found to be the biggest change that new employees must make when transitioning from their studies to industry?

Results

In total, 301 email recipients' were contacted; 27 failed to deliver. Of the 274 emails that were received, there were 98 responses, one of the individuals asked not to be contacted, and five others had not hired employees with a graduate degree. Twenty-three of the respondents responded with a phone call. To engage a larger audience, a post was made in Rainforest Alberta's Slack Channel from which two individuals directly replied to the inquiry for feedback. Of the people contacted, most responses came from managers. Recruiters were poorly engaged: of the 39 individuals reached, only two responded to the questions asked, preventing analysis of the differing views between hiring managers and human resources. All the interviewees responded to the first question asked regarding the skills that they believed graduate degree holders were lacking. However, not all interviewees answered all

the questions, with the question regarding what they thought was the biggest change answered least often.

We learned that recent graduates lacked non-technical skills that could be grouped mainly into project management and customer service skills (see Appendix A). The most frequent concern noted from the data collected from the surveys was with the graduate's ability to lead projects. Some respondents indicated that multiple skill areas were lacking, reporting that both customer service and project management skills were lacking. In total, 94 respondents answered this question.

When the interviewees answered the question what skills graduate degree holders typically excel at, 36 percent of interviewees mentioned their ability to learn new skills, stressing that the technology in their field is constantly changing and that they prioritize the ability to learn over the knowledge job candidates have. One response was excluded that suggested graduates had no skills. Some respondents indicated multiple skills. In total, 73 respondents answered this question.

When interviewees were asked which skill was most linked to career success, communication was the most frequently identified skill that interviewees/respondents mentioned 47 percent of the time as the most important indicator of future career success. Both external and internal communication was mentioned as being important. Forty-two percent of respondents indicating that the most significant

change that new graduates had to make with respect to skill development was related to decision making. Specifically, the need to make faster decisions when you don't have all the information and the ability to understand and balance the stakeholder's interests when making decisions. The question about the biggest change that new employees must make when transitioning to outside academia was the least answered question, with only 29 interviewees/respondents answering the question, most of them answering the question by phone.

Discussion

Graduate students from Canadian biomedical science programs face an uncertain job market (Statistics Canada, 2018). Not surprisingly, students feel that they have little control over their careers. This external locus of control is a significant contributor to the anxiety and depression that is on the rise amongst university graduate students (Dreher, 2019). It is also a primary reason why governments (and the public) are questioning the value of a university education (Bok, 2017). The popular press has begun to portray university graduates as "intelligent idiots" being book-smart but having no tacit knowledge (Taleb, 2018). Accordingly, governments now expect higher educational settings to transfer tacit knowledge through professional experiences (Takwe & Sağsan, 2011). This study reinforces the importance of graduate students pos-

sessing professional skills when graduate students transition to the biomedical workforce. Skills such as critical thinking, problem-solving, and data analytics emerged as assets amongst graduate students from the survey results. Because technology is constantly changing, employers valued these skills more than their technical knowledge upon graduation.

This study also partially supports the proposal that a skills awareness gap exists between graduate students and employers (Craig & Markowitz, 2017). This observation was portrayed by survey respondents/employers' indicating that project management skills were lacking amongst graduate students. Graduate students work on projects that provide exposure to fundamental project management skills. There are several parallels between the graduate thesis and project management: New graduate students start with a charter. They prepare a research proposal, a well-planned document that is vetted by a supervisory committee (i.e., stakeholders) that outlines project scope, schedule, and cost. They conduct procurement management to pursue the project. Progress is monitored and controlled by themselves by meeting with their stakeholders. Finally, like a project manager's final report, they prepare deliverables in the form of a thesis and defend it in committee. Although students are practicing project management skills, they lack the training and awareness to connect these skills and their best practices and the transferability of these skills to

the broader workforce. This lack of instruction and awareness of employer expectations is unfortunate because formal project management training would both help graduate students complete tasks on time, produce higher quality research (Hidalgo, 2019), and better prepare graduate students for professional opportunities.

Project management is experiencing significant growth. By 2027, employers will need 87.7 million individuals to work in project management related roles. Many industries that have historically been non-project-oriented, such as healthcare, have begun to transition to a project-oriented focus (Project Management Institute [PMI], 2017). Canada is expected to need 90,000 new project management jobs by 2027 compared to 2017. If this talent gap is not addressed, \$2.1 billion in Canada's GDP would be at risk (PMI, 2017). By teaching graduate students project management processes early in their program, we will not only better prepare them for success outside academia, but will also make them more productive and disciplined scientists in their studies.

This study also supports the notion that a skills gap exists between graduate students and non-academic employers in the biomedical sector. For example, we were initially surprised by the employers' expectations that graduate students should have customer engagement experience. By having students formally practice integrated knowledge translation, they can gain tacit knowledge of

customer engagement (Graham et. al., 2006). Popular trends, such as lean product development and design thinking suggest that product development teams, including scientists and engineers, should interact with customers early in the product development cycle (Gomory, 1989). By giving students opportunities to develop skills for customer interaction, we can help them become more flexible to employer needs. This also benefits businesses as they can retain the technical knowledge students offer, thus allowing them to be more flexible in the future.

Governments have called for greater research impact by developing knowledge into products that solve a customer's problem (Khazragui & Hudson, 2015). Integrating market pull into research requires the early integration of knowledge consumers (i.e., customers) into the research co-production process (Graham et. al., 2006) (Wyatt et al., 2008). By engaging potential project stakeholders (i.e., customers/employers/industry representatives/leaders) early in the research process, students will become known earlier by potential mentors and employers.

It is important to recognize activities that universities are already doing to address both the skills and skills awareness gap. Providing career advising services, universities help students understand the skills that they have developed through academic activities. A co-curricular record can help recognize on-campus extra-curricular activities, as can

encouraging students to develop and maintain of an individual development plan and an e-portfolio. Regardless, it is important for universities to continue to interact with hiring managers so that learning outcomes can be tied to increased employment success.

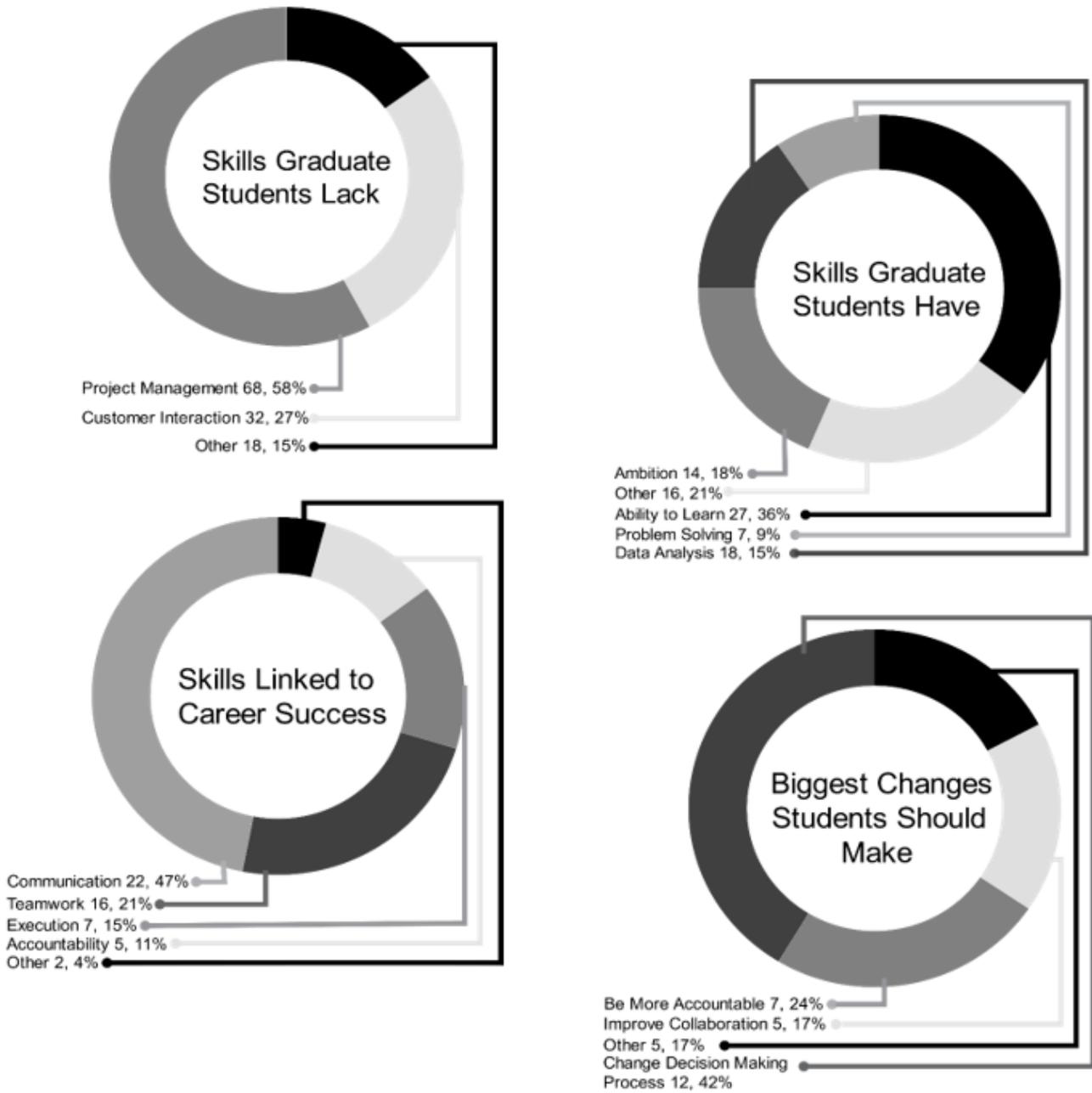
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Appendix A

Figure 1. Sorted Interview Responses.



Appendix B

Table 1. Detailed responses to question 1.

SKILLS / COMPETENCIES LACKING IN BIOMEDICAL GRADUATES	FREQUENCY MENTIONED
Project Management	
General project management	7
Ability to determine points to either discontinue the project or to continue project	2
Ability to determine projects critical path	1
Ability to manage multiple concurrent projects/ understand workflow	9
Ability to prioritize Stakeholders/tasks	7
Ability to use information to make timely Decisions	1
Ability to manage time effectively	14
Ability to set goals and to-do lists	2
Ability to determine quality to which project needs to be completed with	1
Ability to effectively lead successful projects	19
Ability to identify similar projects	1
Ability to see project through multiple stakeholders' perspective such as customers, and business units	1
Ability to effectively communicate progress with team and stakeholders	3
<i>TOTAL PROJECT MANAGEMENT</i>	68
Customer Engagement	
Sales- communicating to customer their value Proposition	19
Ability to identify solutions and provide focused solution	1

Ability to understand market trends	2
Ability to understand larger picture as to why they are doing a certain task	5
Negotiation skills	2
Ability to identify potential customers	3
<i>TOTAL CUSTOMER INTERACTION</i>	32
Other	
Problem solving in business environment	1
Ability to accept new ideas	2
General Communications	10
Ability to work effectively together	1
Ability to deal with failure and use feedback from failure to change	1
Ability to make consistent decisions	1
Ability to work regular business hours	1
Numeracy	1
<i>TOTAL OTHER</i>	18

*some respondents mentioned both customer oriented and project management skills were lacking

Appendix C

Table 2. Detailed responses to question 2.

SKILLS/COMPETENCIES THAT NEW BIOMEDICAL GRADUATES POSSESS	FREQUENCY MENTIONED
Ambition	14
Ability to Learn	
Able to learn new skills	20
Able of staying up to date in their field of Expertise	7
TOTAL ABILITY TO LEARN	27
Problem Solving	
Has ability to be creative	4
Seeks out opinions of others	1
Uses data to make a decision	2
TOTAL PROBLEM SOLVING	7
Data Analysis	12
Other	
Computer skills	2
Presentation skills	6
Positive attitude	6
Willingness to work in teams	2
Determination	1
Social skills	1
TOTAL OTHER	16

*some respondents mentioned multiple skills

Appendix D

Table 3. Detailed response to the question 3

MOST IMPORTANT SKILLS/COMPETENCIES FOR CAREER SUCCESS FOR NEW BIOMEDICAL GRADUATES	FREQUENCY MENTIONED
Communication	
General communication	8
Communicate value to customers	7
Communicate responsibilities and progress with co-workers	7
TOTAL COMMUNICATION	22
Teamwork	
General teamwork	8
Attitude when working with a team	1
Willingness to help and be helped by others	1
Integrity	1
TOTAL TEAMWORK	11
Accountability	
Takes responsibility for outcomes and actions	4
Learns from mistakes/ implements corrective Actions	1
TOTAL ACCOUNTABILITY	5
Execution	
Able to be on budget	1
Able to consistently complete projects	1
Able to meet expectations of different Stakeholders	1
Accomplishes tasks on time	2
Flexible	1
Able to make decisions from available Information	1
TOTAL EXECUTION	7
Other	
Ability to lead	1
Willingness to struggle	1
TOTAL OTHER	2

Appendix E

Table 4. Detailed response to the question 4.

CHANGE IN SKILLS NEW EMPLOYEES TYPICALLY HAVE TO MAKE	FREQUENCY MENTIONED
Decision Making	
Make decisions with incomplete information	1
Balance and take into account stakeholder Interests	1
Quicker timeframes	10
TOTAL FREQUENCY	12
Accountability	
Be able to set completion dates independently	3
Understand how individual performance influences organizational performance	3
improve self-accountability to determine quality	1
TOTAL FREQUENCY	7
Collaboration	
Work within a team with a diverse skillset	4
Be willing to share reasons behind decisions	1
TOTAL FREQUENCY	5
Other	
Work hours	1
Communicate in a professional manner	1
Open to changing focus	1
Working on multiple projects	2
TOTAL FREQUENCY	5