Undergraduate Science Students' Perceptions of Employability: Efficacy of an Intervention

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Abstract

In a recent paper, we reported on the skills needs for graduate employability, as identified from surveys of employers and recent science graduates. In this paper, we report on the outcomes of an intervention designed to address students' skills needs and analyse if it had any impact on their notions of employability. The intervention, conducted as a day-long workshop, was delivered to three groups of third- and fourth-year science students. We used quantitative data to track possible differences in students' self-perceptions of their employability following participation in the intervention. In addition, qualitative data, collected through students' reflective notes, provided insights into how they perceived the value of the intervention in improving their self-perceived employability. Both data types indicate a positive impact of this type of intervention on students' perceptions of their employability and related underpinning skills. Our findings call for a broader integration and evaluation of targeted 'employability' workshops into senior undergraduate or capstone-style curricula.

Background

In a previous issue of the International Journal of Innovation in Science and Mathematics Education, we reported views of recent science graduates and employers from science-based sectors regarding graduate employability and underpinning skills (Sarkar, Overton, Thompson, & Rayner, 2016). Analysing graduates' views, we determined which areas of knowledge and skills developed in their undergraduate degree programmes had been of most use since graduation and to what extent they had been developed within these degree programmes. The analysis indicated a mismatch between knowledge, skills, and capabilities developed in university and those actually required in post-graduation activities. Whilst graduates, irrespective of whether they were employed or engaged in further studies, viewed generic skills as having a higher level of usefulness in workplaces compared to discipline-specific knowledge and skills, many of these skills were not developed in their degree. This finding aligned with the employers' views, with many expressing dissatisfaction with generic skills in graduate recruits. Using these key findings, we designed an intervention for students. This paper discusses how the intervention was designed to bridge the skills gaps reported and its impact on students' perceptions of their employability.

The Intervention

The intervention was designed as an intensive, day-long workshop. The workshop was delivered three times in 2016—twice during the university's orientation week and once after

the examination period. All third- and fourth-year students enrolled in Faculty of Science degrees at Monash University were invited to participate. We considered commercial awareness as the umbrella theme of the workshop, due to its critical importance in the workplace, as expressed by both recent science graduates and employers (Sarkar et al., 2016). Previous research (Forbes & Kubler, 2005; Haines, Rousseau, Brotheridge, & Saint–Onge, 2011; Hanson & Overton, 2010a, 2010b, 2010c; Poon, 2012; Poon & Brownlow, 2014) also considered commercial awareness as one of the key areas in graduate employability, thus reflecting well-reported employer dissatisfaction with the level of commercial awareness of graduate recruits (Archer & Davison, 2008; Connor, Forbes, & Docherty, 2010; Poon, 2012).

While there is no agreed definition of commercial awareness, most share some common aspects (Poon & Brownlow, 2014). Based on the literature (Forbes & Kubler, 2005; Haines et al., 2011; Poon, 2012; Poon & Brownlow, 2014), these include an understanding of (a) an organisation's stakeholders (e.g., customers, suppliers, competitors, managerial bodies) and their demands; (b) the wider environment in which the organisation operates (e.g., economic climate); (c) an employee's role within the organisation, and (d) the economics of business, business benefits and commercial realities from both organisational and customer perspectives. For example, in an industrial setting, if an individual wants to produce something they need to consider the intellectual property aspects, regulations and laws, quality control, marketing strategies, economics and business, which when combined will demonstrate their level of commercial awareness (The Royal Society of Chemistry, 2012).

In addition to commercial awareness, our workshop incorporated other facets of concern regarding graduate capability, including leadership, team-working, problem-solving, communication and mathematical skills, as identified in our previous paper (Sarkar et al., 2016). The following sections detail the workshop content and activities.

Self-evaluation
The intensive workshop commenced with a brief presentation on the skills gaps identified in our recent research (Sarkar et al., 2016). Participants then completed an employability quiz and a skills audit form, both drawn from a published resource (Chin, Grice, & Overton, 2004). The employability quiz, comprising ten multiple-choice questions that centred on what participants think about their future career and their career-readiness, was followed by feedback and discussion. Each quiz question had three possible options (indicated by the letters a, b and c) to choose from. Participants were asked to note which letter appeared most frequently in their answers. The feedback sheet, which included suggestions about what participants should do if most of their answers were one of a, b, or c, was provided at the end of the task. An example of an employability quiz question is given in Appendix 1(a). The skills audit form was designed to help participants identify their current strengths in relation to some of the key skills required for employment. Students answered each question on a continuous scale ranging from 1 to 5, with '1' representing 'low' and '5' 'high'. Appendix 1(b) provides an example of questions designed to help participants understand their problem-solving skills. Participants retained a copy of their audit so that they could reflect on it at a later stage of their degree and discern any changes in these skills.

Panel discussion
A panel comprising recent science graduates and industry personnel was assembled to provide perspectives and discuss issues around science graduate employability. The panel discussion was included to provide students with an opportunity to listen to stories and experience from their predecessors as well as to make some connections and network. Panel membership

represented a range of backgrounds and experiences, including a senior role to develop new strategies and business areas of a chemical manufacturer, a digital analyst, a digital and social media consultant, an education coordinator at Parks Victoria, a statistician at the Bureau of Meteorology, an optometrist, and doctoral and post-doctoral researchers from both Australia and overseas. While the discussion addressed the below pre-determined questions, students were actively involved and asked many questions, resulting in lively and valuable discussions.

Table 1: Questions addressed in the panel discussion

1. How did you get prepared for your career?
2. What job search strategies did you use?
3. How was your experience in the workplace?
4. What are the key skills required to use in the workplace?
5. How can undergrads improve their employability skills?
6. What tips would you offer to undergraduates to be successful at job application?

Encouraging creative thinking

Participants viewed a video on the technique 'SCAMPER', which has been used as a stimulus to promote creative ways of thinking and through this, discover innovative ideas and solutions to large-scale problems (Eberle, 1996). As Eberle outlined, the name SCAMPER is an acronym for the following seven elements:

1. **S**ubstitute—focus on the parts in the product, service or process that can be replaced with another;
2. **C**ombine—analyse the possibility of merging two ideas, stages of the process or product in one single more efficient output;
3. **A**dapt—adjust (from minor to major adjustment) or tweak product or service or use part of another element for a better output;
4. **M**odify—focus on the overall process and change it in a way leading to more innovative solution (including increase or reduce in scale, change in shape or colour);
5. **P**ut to another use—put the existing product or process in another purpose or use it to solve problems;
6. **E**liminate—identify the parts of the existing product or process (unnecessary parts) that can be eliminated to improve (or simplify) it; and
7. **R**everse/Rearrange—explore the innovative potential when changing the order of the process in the production line.

Following the video, participants completed the below task.

You work in a group of 4–5 people. Starting from a basic paper drinking cup discuss how to improve it, or use as a starting point to develop a new product. Ask questions about the product, using each of the seven elements of SCAMPER. Come up with as many ideas as you can without trying to judge the value of them. When finished look at your ideas and judge how viable they are in the process of improving the product or developing a new one. Discuss in group. Spend three minutes for each element.

Share the outcome of this activity with others.

The SCAMPER task was used as a warm-up activity to prepare students for the task below, which addressed commercial awareness—one of the key skills that were identified as skill gap areas for graduate employability.

Promoting commercial awareness
This task commenced with a presentation on the features of commercial awareness, why it is considered a key skill for science graduates, and how students can develop and articulate it, both in job applications and the actual workplace. Students were then presented with the 'New Cinnamon-scented Shampoo Project' (see Appendix 2), and asked to work in small groups of 3–4. The task was inspired by the 'Lemon Bleach' exercises produced as part of the National HE STEM Programme in the UK (The Royal Society of Chemistry, 2012). The original exercises were designed for chemists, which thus required a sound understanding of basic chemistry. In order to cater for the more general science background of our workshop participants, this project did not require specialised chemical knowledge.

Team player *vs* team leader task
Team-working and leadership skills were identified as skill gap areas for science graduates in our previous research (Sarkar et al., 2016). These two skills are important for working effectively in a team, as members may alternately, depending on the task and objective(s), need to perform as a team player and a team leader. The team player *vs* team leader task (Hind & Moss, 2005) aimed to provide participants with a more nuanced understanding of their capacity for team membership or team leadership. The task asked participants to respond, using on a 5-point rating scale, to each of 40 statements. Several statements are presented in Appendix 3a, as examples. Some statements were phrased positively while some were negative. Students calculated their team player and team leader scores (see appendix 3b) and plotted the scores on an aggregate matrix for comparison and better visualisation. Calculating scores and putting them into a matrix also gave students the opportunity to apply their mathematical skills. As Hind and Moss (2005) have described, the matrix places students in one of four zones (see Appendix 3c):

(a) the top left zone, which indicates that they prefer an autocratic style of leadership, as their sense of being a team player is negative;
(b) the top right zone, which indicates both positive leadership and team player abilities;
(c) the bottom left zone, which indicates that they are better working alone than with other people and eventually are neither a team player nor a team leader; and
(d) the bottom right zone, which indicates their ability to work in a team situation with limited ability to lead a team of individuals.

At the end of the task, students were provided with a feedback sheet outlining suggestions to move forward based on the zones they found themselves in.

Career management
The broad consensus amongst graduates regarding their limited awareness of specialised career support and advice available in the university is consistent with what has been previously reported (Hanson & Overton, 2010b; Sarkar et al., 2016; Sharma et al., 2008). Reflecting upon this comment, the workshop included a session in which a dedicated career consultant in the Faculty of Science discussed the range of career support they offer to students, including exploring various career pathways, job search strategies, and job application support (from writing a resume and cover letter and responding to selection criteria to succeeding at an interview).

Methodology

Research approach and methods

As Figure 1 shows, the intensive workshop was designed to address the skills needs identified previously. One objective was for the workshop to extend participants' awareness of employability and underpinning skills with improved occupational self-efficacy and career planning skills. Participants completed a self-perception of employability questionnaire, immediately before and after they attended the workshop, in order to measure possible changes in self-perception of their employability after attending the workshop. Details of this questionnaire are presented in the following sub-section. In addition to the questionnaire, which was quantitative in nature, participants were asked to write reflective notes at the end of the workshop. The reflective notes were centred around participants' responses to a question provided: "please look back at the workshop activities and reflect on how the activities have contributed to improving your employability". The notes provided qualitative data that might provide insights into participants' perceptions of their employability and underpinning skills proficiencies, and how the workshop may have contributed to these.
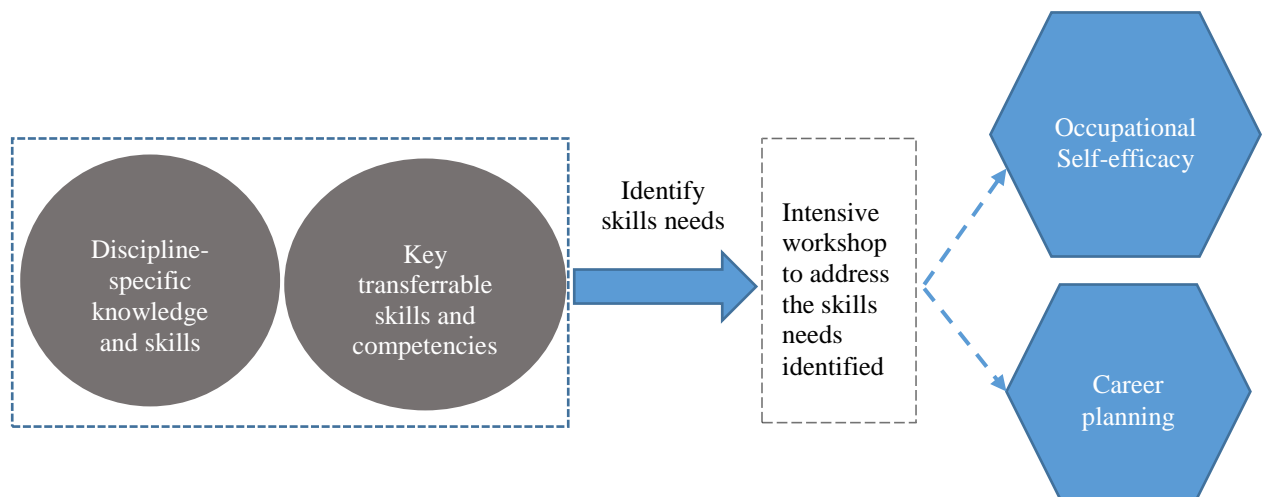

Figure 1: **Research design for the intervention**

From a methodological point of view, as outlined above, we used both quantitative and qualitative data with the view that a more complete picture of human perception and experience can be constructed by combining these two forms of data (Creswell & Plano Clark, 2007; Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2003). In order to construct a complete picture of participants' perceptions of their employability, quantitative data were used to track any difference in participants' self-perception of their employability following participation in the intervention, while the qualitative data provided insights into how they perceived the value of the intervention in improving their employability.

Self-perceived employability questionnaire

The 21-item questionnaire was a modified version of the self-perceived employability test developed and used by Rothwell and colleagues (Rothwell, Herbert, & Rothwell, 2008; Rothwell, Jewell, & Hardie, 2009) to examine the expectations and self-perceptions of employability of business students at undergraduate and post-graduate levels in the UK. The questionnaire items were clustered into two sub-scales: career planning and occupational self-efficacy. The sub-scale "career planning" included 13 items that addressed participants'

concerns about university reputation with employers, demand in the extended labour market, and awareness of career goals. Items in this sub-scale included, for example, "Employers are eager to employ graduates from my university"; "The career I am aiming for is in high demand in the labour market"; and "I feel I need to work hard to develop the skills required to achieve my career goals". The remaining eight items formed the sub-scale "occupational self-efficacy" that probed participants' beliefs in their ability to develop skills and attributes for the desired occupation. Items in this sub-scale included, for example, "I am confident in my ability to prepare a high-quality job application"; "I am confident of success in job interviews"; and "In order to increase the likelihood of gaining employment, I will need skills and attributes in addition to those developed in my degree". Responses to each question were ranked on a 5-point Likert rating scale from "strongly disagree" to "strongly agree".

The overall self-perceived employability questionnaire had good internal consistency, with a Cronbach alpha coefficient reported of .82 (DeVellis, 2012). The sub-scales "career planning" and "self-efficacy belief" had acceptable internal consistency, with Cronbach alpha coefficients of .74 and .71 respectively (DeVellis, 2012).

Data analysis
The questionnaire data, which were quantitative in nature, were analysed using SPSS. As noted previously, students responded to the same questionnaire on two occasions—once before and once after they attended the workshops. Questionnaire data were considered ordinal in nature as they were collected on a rating scale. Considering the ordinal nature of data with repeated measures, we employed the Wilcoxon Signed Rank Test (Wilcoxon, 1945) to compare the pre- and post-workshop data. Wilcoxon Signed Rank Test is a non-parametric version of a paired *t*-test (Nahm, 2016). Instead of comparing means (which is done in a paired *t*-test), the Wilcoxon converts scores to ranks and compares them on two occasions, which is why the median is considered the most appropriate measure for this test (Lowry, 2006; Pallant, 2016).

NVivo was used to analyse qualitative data generated via the reflective notes, written by the workshop participants. In order to develop a deeper understanding of the reflective notes, they were read several times (Creswell, 2008) before emergent themes were identified and codes assigned to each. Although NVivo was used to manage coding, all coding was performed manually, with written responses interpreted in context rather than as target words or phrases. The first author of this paper solely assigned codes to the qualitative data and the codes were cross-checked and discussed in weekly meetings with the co-authors and other members of the group. This approach helped to maximise the reliability of the analysis.

Participants
A total of three day-long workshops were delivered to three distinct groups of students, comprising a total of 75 students from across the Faculty of Science (Table 2).

Table 2: Background of the participant students

Year of study	Gender		Total
	Female	Male	
3rd Year	28	22	50
4th Year (Honours)	20	5	25
Total	48	27	75

Findings

The findings are presented in two sections. The first section, based on quantitative data from the self-perceived employability questionnaire, investigates possible difference in participants' self-perception of employability following participation in the intensive workshop. The second section analyses qualitative data collected from participants' reflective notes and discusses how they reflect on their employability following participation in the workshops.

Participants' self-perception of employability
Table 3 presents an analysis of data collected using the self-perceived employability questionnaire at two points—once before and once after the students attended the workshops. A Wilcoxon Signed Rank Test revealed a statistically significant improvement in participants' self-perception of employability following participation in the workshops ($z = -3.11$, $p < .01$), with a small–medium effect size ($r = .25$). The median score on the scale items increased from pre-workshop ($Md = 76.0$) to post-workshop ($Md = 79.0$).

Table 3: Self-perceived employability statistic

	Number of items	*Md* (pre-)	*Md* (post-)	*z*	*p*	*r*
Self-perceived employability questionnaire (total)	21	76.0	79.0	-3.11	.002	.25
Sub-scale 1: Career planning	13	48.0	48.0	-1.43	.154	.12
Sub-scale 2: Occupational self-efficacy	8	30.0	31.0	-3.46	.001	.28

Table 3 also presents an analysis of data based on the two sub-scales: career planning, and occupational self-efficacy.

Career planning
A Wilcoxon Signed Rank Test revealed no significant difference in participants' perception of career planning following participation in the workshop ($z = -1.43$, $p = .154$). The median score on the scale items remained unchanged ($Md = 48.0$).

Occupational self-efficacy
A Wilcoxon Signed Rank Test revealed a statistically significant improvement in participants' occupational self-efficacy following their participation in the workshop ($z = -3.46$, $p < .01$),

with a medium effect size (r = .28). The median score on the scale items increased from pre-workshop (Md = 30.0) to post-workshop (Md = 31.0).

Participants' perceptions of the value of the workshop
This section presents an analysis of participants' reflective notes. Participants developed these notes, reflecting on how they thought the workshop improved their understanding of their own employability. Each participant compiled their own set of notes. An analysis of the notes revealed two major themes: (a) participants perceived that the workshop helped them build awareness of employability and underpinning skills; and (b) the workshops provided them with an opportunity to develop some of the skills. A detailed analysis is presented below.

Building awareness
Sixty-three participants (84%) considered that the workshops helped build their awareness of employability and underpinning skills. A closer look at these responses further revealed a number of sub-themes, based on their frequency (in descending order) as articulated in Table 4.

As Table 4 shows, participants indicated that they better recognised the key skills valued by employers as well as helped them articulate the skills they already had. Participants also recognised that the workshop helped their self-evaluation of preparedness for their post-graduation career. They commented on the feedback that they received following the self-evaluation tasks, which contributed to developing a notion of confidence. Participants also acknowledged that the workshop contributed to developing their awareness of the value of networking for a career. They also recognised how the workshop provided an opportunity to build a network with the alumni and industry panel and other students. Reflective notes highlighted the workshops' contribution to making participants more aware of the availability of and their access to resources in job-finding and improving the skills required for such. Participants' responses reflected how the workshop informed their understanding of the job application process and better prepare an effective job application. In addition, participants opined that the workshop had contributed to building their awareness of the range of career pathways that their science degrees could potentially lead to.

Table 4: Participants' reflection on how the workshop contributed to building awareness

Sub-themes and associated categories	Example quote
Recognising the skills important for employment (N = 48)	*It has provided me with knowledge about what employers are looking for in their employees and the skills that are required in any workplace such as teamwork and problem solving skills.*
• Articulating the skills already had (n = 9)	*I believe that I have learned how to unblock the skills I already have and make them obvious to employers.*
Self-evaluation (N = 37)	*This workshop has identified my strengths and weaknesses clearly in terms of employment skills and career development. The next step that I need to take when finishing are clear to me.*
• Receiving feedback on the self-evaluation task (n = 11)	*Based on my responses I got detailed idea of where I am on now and what I need to do. This is pretty helpful.*

• Achieving confidence from the self-evaluation process (n = 8)	*It has given me the confidence to evaluate myself in a completely new way with job applications in mind. To hopefully sell myself better and highlight what I need to work on, but also what I excel at.*
Networking (N = 16)	*I have really learned how important networking is in the science work field. This workshop has taught me that I need to venture out and contact people in my field to increase my opportunities and job prospects, graduate programs etc. and sure I've practised this when talking with the panel and other students.*
Access to and availability of the resources (N = 15)	*It has made me aware of the wide range of resources Monash has available for developing employability / finding employment.*
• Informing to look at various job sources and courses in order to improve skills (n = 6)	*It gave me some info on sources of jobs to find and other places/ groups/ courses that I can take to improve my skills.*
Preparing an effective job application (N = 11)	*Learned more about what works when applying for jobs and what does not, what to include in your resume and cover letter and what not.*
• Worth of panel discussion to understand the job application process (n = 3)	*The interaction with the alumni and industry people was great. Being actively involved in question time of guest presenters has assisted me in understanding the interview and application process.*
Career pathways (N = 9)	*Showed me that there are many pathways, where I could look and there are past alumni who have a similar experience.*

Developing skills

Forty-eight participant responses (64%) recognised that the workshops contributed to developing some of the key skills that the employers value. Below is an example.

> *It forces me to problem-solve, work in a team and take part in an oral presentation which was a good experience that will hopefully develop me in that area.*

Table 5 presents what specific skills participants thought were recognised and/or developed during the workshop. The table is arranged on how many times each of the skills appeared in participants' reflective notes.

Table 5: Skills recognised and/or developed in the workshop

Skill	Example quote
Team-working (N = 35)	*Solving the shampoo proposal problem was challenging, but I think it showed me the value of teamwork as it was actually easier to do in a team (I expected it to be harder)*
Commercial awareness (N = 25)	*Awareness of how an industry works and what business things I need to consider before I make a job application. The business side and application of technical skills through the cinnamon shampoo case study.*
Communication (N = 18)	*An important skill I have improved on during this workshop is to communicate ideas with others, mostly verbally. It was a challenge when answered to students' question after our presentation, but think I was fine.*
Networking (N = 18)	*I have really learned how important networking is in the science work field. This workshop has taught me that I need to venture out and contact people in my field to increase my opportunities and job prospects, graduate programs etc. and sure I've practiced this when talking with the panel and other students. I am not that shy now to approach.*
Creative thinking (N = 16)	*I've gained greater creative thinking through activities like SCAMPER that can be used to explore other avenues in coming up with novel ideas.*
Leadership (N = 13)	*Team leadership – motivating others, negotiating, playing the key role. Practised some when did the task with others. I now recognise me with a leadership preference after the activity of what kind of person I am – leader or a player.*
Problem-solving (N = 10)	*I think I have improved my problem solving skills when I did the shampoo activity. It was an interesting challenge.*
Mathematical skills (N = 7)	*It took some time to calculate my scores for leader and team player. After I put them on the quadrate, it was easy to see my style.*

As Table 5 illustrates, a total of eight skills were mentioned in participants' reflective notes. Of these skills, team-working and commercial awareness received the higher attention by participants as compared to other generic skills.

Discussion and conclusions

In this paper, we report on the design of an intervention aimed at addressing skills needs identified for graduate employability and its impact on participants' perceptions of their employability.

The significant increase in participants' self-perception of their employability, especially in their occupational self-efficacy, demonstrates an important outcome of the intervention. Self-efficacy, which refers to an individual's belief in their abilities and tendencies to perform a task, affects their belief regarding whether or not certain goals may be achieved (Bandura, 1977, 1997). If an individual perceives certain goals to be beyond their ability to achieve, they may not act, irrespective of a perceived social demand of the goals (Boyd & Vozikis, 1994). People with a high sense of self-efficacy set more challenging goals and act with stronger commitment to achieving these goals (Gist, 1987). A high sense of self-efficacy also affects skills acquisition and the level of persistence demonstrated when facing difficulties (Bandura, 1982, 1997; Betz & Hackett, 1997; Zimmerman, 2000). Considering these notions of self-efficacy, it is possible that participants' improved self-efficacy, generated by their engagement in the intervention, may subsequently enable them to set more challenging career goals and act with persuasion and persistence to develop the required skills for attaining those goals.

The scholarly literature on reflection suggests that it has the potential to affect both self-efficacy and task understanding, which together make the learning experience more productive and thus generate higher rates of learning (Di Stefano, Gino, Pisano, & Staats, 2016; Kale & Singh, 2007). In our study, participants' improved occupational self-efficacy may have been generated by either the written reflective task or the workshop activities, or perhaps a combination of both. An analysis of participants' reflective notes revealed how the workshop contributed to building their awareness of employability, with specific reference to recognising key employability skills and self-evaluating those skills. We find this an encouraging finding, as from an employability perspective, it is important for students to identify and focus on the key employability skills they need to develop expertise, what their strengths and weaknesses are with reference to those skills, and their thoughts about what they might do next to develop them. This approach may enable undergraduates to better articulate their skills to prospective employers, build their self-confidence and promote their work readiness (Mackaway, Winchester–Seeto, & Rowe, 2012; Pegg, Waldock, Hendy–Isaac, & Lawton, 2012).

In addition to building participants' awareness of their employability, a majority of them reported that the workshop activities were helpful in developing some key employability skills, in particular team-working and commercial awareness. Given the importance of these skills in enhancing the employability of graduates (Lowden, Hall, Elliot, & Lewin, 2011; Prinsley & Baranyai, 2015), we suggest that they be more fully embedded in undergraduate curricula, particularly in capstone or similar subjects offered near completion of a science degree.

The value participants placed on the alumni and industry personnel presentations related to three themes: (i) the enabling of more informed career choices, (ii) opportunities to meet career role models and (iii) the building of professional networks (Sarkar et al., 2016). Participants commented on the value of the panel discussions, with specific reference to networking, better understanding job application and interview processes, and exploring different career options after gaining a science degree. Panel members also enjoyed being a part of the workshop and demonstrated a desire to participate in future. For example, one panel member commented: "A great program for the students. That sort of work is very important, so well done! I'd be very happy to help again in the future." (S. Watkins, personal communication, November, 25, 2016). This suggests that more embedded and sustained collaboration with alumni and industry personnel may promote broader university–industry collaboration, which in turn may provide more placement and networking opportunities for students, and positively impact their employability.

In summary, the workshop designed in this study positively impacted participants' perceptions of their employability and underpinning skills. An implication of this finding for future research would be to study workshop participants' longer-term use of skills and knowledge in their post-graduation activities and compare them with their experience on the workshop tasks, in order to investigate the sustainability of the learning gains. The workshop was delivered as an extra-curricular programme and only a small proportion of potential students engaged in it. Given the increasing need for higher education institutions to more effectively develop and promote employability (Boden & Nedeva, 2010; Bridgstock, 2009), this type of programme has the potential to be an essential part of undergraduate science curricula, to the greater benefit of students studying science.

References

Archer, W., & Davison, J. (2008). *Graduate employability: What do employers think and want?* London, UK: The Council for Industry Higher Education.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215. doi: http://dx.doi.org/10.1037/0033-295X.84.2.191

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122–147. doi: 10.1037/0003-066X.37.2.122

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Betz, N. E., & Hackett, G. (1997). Applications of self-efficacy theory to the career assessment of women. *Journal of Career Assessment, 5*(4), 383–402. doi: 10.1177/106907279700500402

Boden, R., & Nedeva, M. (2010). Employing discourse: Universities and graduate 'employability'. *Journal of Education Policy, 25*(1), 37–54. doi: 10.1080/02680930903349489

Boyd, N. G., & Vozikis, G. S. (1994). The influence of self-efficacy on the development of entrepreneurial intentions and actions. *Entrepreneurship Theory and Practice, 18*, 63–77.

Bridgstock, R. (2009). The graduate attributes we've overlooked: Enhancing graduate employability through career management skills. *Higher Education Research & Development, 28*(1), 31–44. doi: 10.1080/07294360802444347

Chin, P., Grice, D., & Overton, T. (2004). *Employability resource pack: Resources designed to help students of the physical sciences develop skills for employment*. Hull, UK: The Higher Education Academy Physical Sciences Centre.

Connor, H., Forbes, P., & Docherty, D. (2010). Talent fishing: What businesses want from postgraduates. London, UK: The Council for Industry and Higher Education.

Creswell, J. W. (2008). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (3rd ed.). Upper Saddle River, NJ: Pearson Merrill Prentice Hall.

Creswell, J. W., & Plano Clark, V. L. (2007). *Designing and conducting mixed methods research*. Thosand Oaks, CA: Sage.

DeVellis, R. F. (2012). *Scale development: Theory and applications* (4th ed.). Los Angeles, CA: Sage.

Di Stefano, G., Gino, F., Pisano, G. P., & Staats, B. R. (2016). Making experience count: The role of reflection in individual learning. *Harvard Business School NOM Unit Working Paper No. 14–093*. doi: http://dx.doi.org/10.2139/ssrn.2414478

Eberle, B. (1996). *SCAMPER: Games for imagination development*. Waco, TX: Prufrock Press.

Forbes, P., & Kubler, B. (2005). Employability: Employer perceptions of subject benchmark statements. London, UK: The Council for Industry and Higher Education.

Gist, M. E. (1987). Self-efficacy: Implications for organizational behavior and human resource management. *The Academy of Management Review, 12*(3), 472–485. doi: 10.2307/258514

Haines, V. Y., Rousseau, V., Brotheridge, C. M., & Saint–Onge, E. (2011). A qualitative investigation of employee business awareness. *Personnel Review, 41*(1), 73–87. doi: 10.1108/00483481211189956

Hanson, S., & Overton, T. (2010a). *Skills required by new chemistry graduates and their development in degree programmes*. Hull, UK: Higher Education Academy UK Physical Sciences Centre.

Hanson, S., & Overton, T. (2010b). *Skills required by new forensic science graduates and their development in degree programmes*. Hull, UK: Higher Education Academy UK Physical Sciences Centre.

Hanson, S., & Overton, T. (2010c). *Skills required by new physics graduates and their development in degree programmes*. Hull, UK: Higher Education Academy UK Physical Sciences Centre.

Hind, D., & Moss, S. (2005). *Employability skills*. Sunderland, UK: Business Education Publishers.

Johnson, B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14–26.

Kale, P., & Singh, H. (2007). Building firm capabilities through learning: The role of the alliance learning process in alliance capability and firm-level alliance success. *Strategic Management Journal, 28*(10), 981–1000. doi: 10.1002/smj.616

Lowden, K., Hall, S., Elliot, D., & Lewin, J. (2011). *Employers' perceptions of the employability skills of new graduates*. London, UK: Edge Foundation.

Lowry, R. (2006). *Concepts and applications of inferential statistics*. New York, NY: Vassar College.

Mackaway, J., Winchester–Seeto, T., & Rowe, A. (2012). *How do I measure up? Supporting student selfassessment in skills and graduate attributes.* Paper presented at the Australian Collaborative Education Network (ACEN) National Conference, Melbourne, Australia.

Nahm, F. S. (2016). Nonparametric statistical tests for the continuous data: The basic concept and the practical use. *Korean Journal of Anesthesiology, 69*(1), 8–14. doi: 10.4097/kjae.2016.69.1.8

Pallant, J. (2016). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. Crows Nest, Australia: Allen & Unwin.

Pegg, A., Waldock, J., Hendy–Isaac, S., & Lawton, R. (2012). *Pedagogy for employability*. York, UK: Higher Education Academy.

Poon, J. (2012). Real estate graduates' employability skills: The perspective of human resource managers of surveying firms. *Property Management, 30*(5), 416–434. doi: 10.1108/02637471211273392

Poon, J., & Brownlow, M. (2014). Students' views on the incorporation of commercial awareness in real estate education. *Property Management, 32*(4), 326–351.

Prinsley, R., & Baranyai, K. (2015). STEM skills in the workforce: What do employers want? *Occasional Paper Series*. Canberra, Australia: Office of the Chief Scientist.

Rothwell, A., Herbert, I., & Rothwell, F. (2008). Self-perceived employability: Construction and initial validation of a scale for university students. *Journal of Vocational Behavior, 73*(1), 1–12. doi: http://dx.doi.org/10.1016/j.jvb.2007.12.001

Rothwell, A., Jewell, S., & Hardie, M. (2009). Self-perceived employability: Investigating the responses of post-graduate students. *Journal of Vocational Behavior, 75*(2), 152–161. doi: http://dx.doi.org/10.1016/j.jvb.2009.05.002

Sarkar, M., Overton, T., Thompson, C., & Rayner, G. (2016). Graduate employability: Views of recent science graduates and employers. *International Journal of Innovation in Science and Mathematics Education, 24*(3), 31–48.

Sharma, M., Pollard, J., Mendez, A., Mills, D., O'Byrne, J., Scott, D., . . . Zealey, W. (2008). What does a physics undergraduate education give you? A perspective from Australian physics. *European Journal of Physics, 29*(1), 59–72.

Tashakkori, A., & Teddlie, C. (Eds.). (2003). *Handbook of mixed methods in social and behavioral research*. Thousand Oaks, CA: Sage.

The Royal Society of Chemistry. (2012). Business skills and commercial awareness for chemists. Retrieved 6 April, 2016, from http://www.rsc.org/learn-chemistry

Wilcoxon, F. (1945). Individual comparisons by ranking methods. *Biometrics Bulletin, 1*(6), 80–83. doi: 10.2307/3001968

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology, 25*(1), 82–91. doi: http://dx.doi.org/10.1006/ceps.1999.1016

Appendices

Appendix 1(a)

Is your CV up to date with all relevant work experience detailed?

(a) Yes

(b) It needs updating but most of the relevant information is included

(c) I have not written my CV yet

Appendix 1(b)

When dealing with problems do you:	1 (Low)	2	3	4	5 (High)
define problems carefully before trying to solve them?					
logically work through a problem to reach a conclusion?					
adapt and apply rules/applications from other situations that may be relevant to this problem?					
make full use of available resources in order to solve the problem?					
look at problems from different perspectives and generate multiple solutions?					
evaluate potential solutions to choose the best one?					
refuse to feel dispirited when the solution to the problem is not readily apparent?					

Appendix 2

New Cinnamon-scented Shampoo Project

The context

You work as a chemist at a custom synthesis company. Your company aims at expanding its business by producing and marketing personal care products (e.g., shampoo).

You have prepared three specific new compounds which offer unique and distinctive fragrance of cinnamon when blended with other known fragrance components used in producing shampoo. To best of your knowledge, there is no cinnamon-scented shampoo in the market. You conclude that from a perfumery point of view there is a potential to build a business on the back of a new 'cinnamon-scented shampoo' product line.

Instead of trying to convince an existing shampoo manufacturer to adopt your distinctive new fragrance, you will convince your company management to produce and sell the cinnamon-scented shampoo under the company name. Your company will buy the base ingredients used to manufacture shampoo and the other known fragrance components, but it will produce the novel compounds at its own site and blend them together to get the novel cinnamon-scented shampoo. The company will also do packaging, distribution, and marketing.

Task to be completed

Produce a pitch to your company's senior management with a view to expanding its business by supplying its own brand of distinctively fragranced shampoo. While producing the pitch, you should consider:

1. The IP landscape: What things do you need to consider if you want to produce and use the novel compound as perfume components? How will you protect your ideas?
2. Regulation: What regulations need to be met in the production of chemicals for use in household products in order to protect your workforce and the consumers?
3. Quality: What quality measures need to be met to validate production of this type of product?
4. Marketing: How will you establish brand identity in order to penetrate a well-established market?
5. Budget: How much will it cost to produce the new cinnamon-scented shampoo? Can you prepare an estimated budget (using the table below)? You may use MS Excel to prepare the budget. Please include in your pitch how you would consider the costs associated with labour, packaging, quality control, and marketing.
6. Business: Why should the company approve your proposal? How will the new design fit in the commercial environment in which your company operates?

Pitch length: 3 minutes

You will be provided with a list outlining costs associated with typical shampoo manufacturing.

Shampoo manufacturing cost

The below table shows costs for the ingredients and standard proportion used in typical shampoo manufacturing. Both the costs and proportions are in a rough estimate.

Ingredient category	Ingredient	Unit	Price (AUD)	Standard proportion
Aqua	Water	1 litre	0.5	80 litre
Water softener	EDTA Disodium	1 kg	49.50	0.1 kg
Detergent	Sodium Lauryl Sulfate	1 kg	80	2.5 kg
	Sodium Xylenesulfonate	1 kg	88	0.5 kg
Foaming agent	Cocamide DEA	1 kg	11	1.55 kg
Conditioning and special effect agents	Cetrimonium Chloride	1 kg	22	0.5 kg
	Glycol Distearate	1 kg	33	0.2 kg
	Keratin (Amino Acids)	1 kg	176	0.1 kg
Preservative	Sodium Benzoate	1 kg	22	0.2 kg
Buffering agent (pH balance)	Sodium Citrate	1 kg	50	0.2 kg
	Citric acid	1 kg	8.25	0.40 kg
Perfumery agents	Citrus Fragrant Oil	1 litre	143	Sufficient quantity
	New compound (Cinnamon scented Oil)	1 litre	155	Sufficient quantity

Appendix 3a: Team player *vs* Team leader task

How much do you agree or disagree with the following statements? You can indicate your response by putting an X in each row. Please read the statements carefully as some statements are phrased positively while some are negative.

	Statements	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1	I usually prefer to work alone.					
2	Team working means utilising a variety of skills in order to achieve something.					
3	I am not afraid to speak my mind.					
4	I prefer to be told what to do.					
5	Group work means that I do not have to do as much.					

Appendix 3b: Scoring responses

Once you have placed an X for each row, it is time to score your response by using the grid provided.

You will calculate your team player score by adding up the individual score for each of the statement numbers:

1, 2, 5, 6, 9, 10, 13, 14, 17, 18, 21, 22, 25, 26, 29, 30, 33, 34, 37, 38

Similarly, you will calculate your team leader score by adding up the individual score for each of the statement numbers:

3, 4, 7, 8, 11, 12, 15, 16, 19, 20, 23, 24, 27, 28, 31, 32, 35, 36, 39, 40

Both your team player and team leader scores range between -40 and +40.

The Grid

	Statements	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
1	I usually prefer to work alone.	-2	-1	0	1	2
2	Team working means utilising a variety of skills in order to achieve something.	2	1	0	-1	-2
3	I am not afraid to speak my mind.	2	1	0	-1	-2
4	I prefer to be told what to do.	-2	-1	0	1	2
5	Group work means that I do not have to do as much.	-2	-1	0	1	2

Appendix 3c: Matrix with feedback