

# Effects of Online Career Training Modules on Undergraduate STEM Students' Career Readiness Perceptions

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Received March 04, 2023; Revised April 08, 2023; Accepted April 17, 2023

**Abstract** A challenge in higher education is promoting the development of employability skills to meet employer expectations post-graduation. This study aimed to determine the effect of an optional online career readiness training resource, consisting of four training modules, on students' career readiness perceptions [Training Module (n=102) versus untrained Control (n=58)]. Training Module students reported increased overall job readiness and understanding of career opportunities, translation of skills to the workplace, employer expectations and the ability to meet those expectations compared to the Control Group. Additionally, career readiness perceptions were negatively correlated with stress levels, indicating that the more prepared students felt regarding career readiness the lower their stress experience. Both development of key employability skills and traits and career readiness perceptions were positively correlated with a deep learning approach, highlighting the importance of learning approach in post-graduation preparation. This study was conducted during the COVID-19 pandemic and students' perceived stress levels increased during the academic semester ( $P < 0.05$ ), however, there was no difference in overall stress levels between the Training Module and Control Group. Additionally, within the Training Model Group perceived stress levels were inversely correlated with career readiness perceptions, including identifying a career path, awareness of workplace expectations, confidence in meeting employer expectation and overall job readiness. Collectively, this study demonstrates the value of additional career planning training to support students transitioning out of undergraduate programs and identifies the impact of both learning approach and stress on students' overall perceptions of their job readiness.

**Keywords:** career readiness, employability skills and traits, stress, learning approach, COVID-19

**Cite This Article:** Teresa Siby, Jamie L.A. Martin, Jessie M. Burns, David M. Beauchamp, Payal Patil, Heather Pollock, Janie P. Vu, and Jennifer M. Monk, "Effects of Online Career Training Modules on Undergraduate STEM Students' Career Readiness Perceptions." *American Journal of Educational Research*, vol. 11, no. 4 (2023): 214-224. doi: 10.12691/education-11-4-5.

## 1. Introduction

Emphasis on career readiness is an increasingly important facet of undergraduate education, particularly within Science, Technology, Engineering and Mathematics (STEM) programs, due to demands driven by employers and graduate/professional schools [1]. Employers have reported being dissatisfied by the "work ready" skill competencies of STEM program graduates [2]. Thus, it is essential for undergraduate students to develop professional skills that maximize marketability and employability [3] in order to meet employers' expectations [3]. At the end of an undergraduate program, these employability expectations include, but are not limited to, a well-established set of skills (e.g., problem solving, critical

thinking, scientific literacy and collaboration) that provide the foundation for continued education or direct employment [4,5]. However, development of these skills is limited for many university graduates, and therefore, institutions are aiming to resolve this gap in students' professional and transferable skills by redesigning the curricula to promote and centralize career readiness training [6]. Programs offering career preparation courses (that emphasize workplace preparation while concomitantly earning course credit towards program requirements) have reported positive student outcomes, such as higher graduation rates, lower overall credit hours to earn a degree, and higher levels of academic performance [7]. It is recommended that this process start early in the undergraduate program to promote career development and ensure a seamless transition for graduates into the workplace [8].

Due to the COVID-19 pandemic, more university graduates have reported facing mental health issues related to academic stress and career instability [9]. The shift to online learning negatively impacted both physical and mental health as university students were forced to stay at home and adapt to the unusual and unexpected teaching and learning approaches of online education [10,11]. Prior to the COVID-19 pandemic, university students reported a lack of mental health management, the presence of psychosocial disturbances (i.e., personal issues or depression), and high levels of academic stress [12,13,14], which may have worsened during the change to online learning. Stress is a factor that contributes to negative mental health issues in university students [15]. In a large cohort of over 1000 university students during “home-quarantine”, the prevalence of depression, anxiety, and stress was found to be 78.7%, 67.9% and 58.7%, respectively [16]. Importantly, stress has been shown to negatively affect youth perceptions of career readiness [17]. Conversely, improvement of student well-being has been shown to be positively correlated with the improvement of perceived employability [9]. Graduates who are proactive about career decision-making report higher levels of perceived career readiness and lower levels of perceived stress [9,18]. Thus, when a student feels more employable, they will achieve greater levels of academic engagement and lower levels of stress [9].

The objective of this study was to determine if career preparation content, such as engagement with an optional career readiness training module, can influence students' i) perceptions of their core employability traits, ii) career readiness perceptions, iii) academic stress, and iv) learning approach.

## 2. Methods

### 2.1. Participants, Online Course Delivery, and Career Readiness Module

Participants in this study (n=160) were third- and fourth-year undergraduate students enrolled in a fourth-year nutritional science course in the Fall 2021 semester at a research-intensive comprehensive university. Due to the COVID-19 pandemic, the course was delivered online in the standard 12-week format with two asynchronous video lectures uploaded to the course website each week. A reflective career readiness assignment was included in the course worth 5% of students' final grade. Students were encouraged to access the online career readiness training resource that was created within the College of Biological Science (CBS) and is available to all CBS undergraduate students. This online training resource takes approximately 8-16 hours to complete and aims to prepare students in STEM majors for future careers in the field through four modules focussing on self-discovery, career exploration, career planning, and self-marketing. In addition to the embedded modules and associated engagement activities, additional workshops and one-on-one support from career advisors were also available. For this study, students were self-divided into two groups based on their level of engagement with the online career readiness training resource and completion of the Skills Assessment Survey

within the self-discovery module of the course. The Skills Assessment Survey provides an indication of students' level of skill competency in relation to several core employability traits/skills that are important to develop during an undergraduate STEM program, are vital for future success in the workplace [19,20], and also align with the institution's undergraduate program learning outcomes. Therefore, there was a Training Module Group that completed and fully engaged with the four modules found within the career readiness training resource, including the Skills Assessment Survey (n=102; 63.8% of participants) and a Control Group that did not complete any components of the training resource (n=58; 36.2% of participants).

### 2.2. Online Surveys

In addition to engagement with the online career readiness resource, students were invited to complete two identical online surveys at the beginning (week 1, Survey 1) and one at the end (week 12, Survey 2) of the semester. The online surveys utilized the Qualtrics Insight Platform (Provo, UT, USA) and were distributed using a private link sent to students' university email address. The survey questions assessed students' perceived stress levels using the validated Perceived Stress Scale (PSS) [21] and their career readiness perceptions using questions developed by the research team. Additionally, at the end of the semester students' learning approach (i.e., surface versus deep) was assessed using the validated two-factor Revised Study Process Questionnaire (RSPQ-2F) [22]. Learning approach includes students' learning strategies and motivations, wherein a surface approaches can involve completing or engaging in the minimum requirements and/or relying upon rote memorization, whereas deep approaches can involve higher engagement, personal satisfaction and interest in learning with the intention of understanding content [22]. A 2% participation bonus was added to students' midterm exam grade for participation in Survey 1 and a 2% bonus was added to student's final exam grade for participation in Survey 2. Alternative assignments were provided for students to earn the participation bonus while abstaining from the surveys. Only students who completed both surveys were included in the analysis. Of the 191 students enrolled in the course, 160 completed both surveys (n=102 in the Training Module Group and n=58 in the Control Group), corresponding to a participation rate of 83.8%. This study was approved by the University of Guelph Research Ethics Board (REB#20-10-026) and all participants provided their informed consent.

### 2.3. Statistical Analysis

Statistical analyses were conducted using GraphPad Prism (San Diego, CA, USA). For all data, the predefined upper limit of probability for statistical significance was  $P \leq 0.05$ . Values are presented as mean values with the standard error of the mean (SEM). Paired t-tests were used to determine the change over the semester (i.e., Survey 1 versus Survey 2) for students' perceived stress, learning approach, and career readiness perceptions. Pearson correlations were conducted to determine the relationship among students' learning approach, stress levels, students'

career readiness perceptions, and competency in having developed core STEM employability traits.

### 3. Results

#### 3.1. Changes during the Semester in Students' Career Readiness Perceptions and Stress

Changes in undergraduate students' career readiness perceptions during the semester are shown in Table 1. Students in the Training Module Group increased their perceptions of receiving sufficient training related to career planning, and the magnitude of this increased perception of training adequacy was significantly greater compared to the Control Group ( $P=0.022$ ). Additionally, students in the Training Module Group reported increased confidence in their i) identification of a future career path, ii) preparation to graduate with knowledge of STEM career opportunities, iii) comprehension of STEM employment sectors, iv) feeling equipped with knowledge of STEM career opportunities, iv) ability to translate undergraduate program skills into the workplace, v) awareness of the skills and attributes expected in the STEM workplace, vi) understanding of employer expectations and vi) feelings of preparedness to meet employer expectations ( $P<0.05$ , Table 1). Students in both the Control and Training Module Groups reported increased confidence in their overall job readiness over the course of the semester (i.e., between Survey 1 and Survey 2); however, confidence levels were higher in the Training Module Group (Table 1).

Students' overall perceived stress levels, which includes both academic and non-academic sources of stress, were measured at both the start and end of the semester, as shown in Figure 1. The mean change in stress scores over the course of the semester (i.e., between Survey 1 and Survey 2) did not differ between the Control and Training Module groups ( $P=0.29$ ); however,

perceived stress scores did increase in both groups over the course of the semester ( $P<0.05$ ). In both groups, the overall perceived stress score of 30 (out of 56) at the end of the semester (i.e., Survey 2 PSS score) was not indicative of elevated perceived stress levels [21].

The relationship between students' career readiness perceptions and their perceived stress scores is shown in Table 2. There were significant inverse relationships between students in the Training Module Groups' perceived stress levels and the following career preparation perceptions including i) receiving sufficient training regarding career planning, ii) identifying a future career path, iii) knowledge of STEM career opportunities, iv) awareness of skill expectations in the STEM workplace, v) feeling prepared to meet employer expectations, and vi) confidence in overall job readiness. This indicates that students with higher career readiness perceptions and confidence had lower overall stress levels. Conversely, there were no significant relationships between students' stress levels and career readiness perceptions in the Control Group ( $P>0.05$ ).

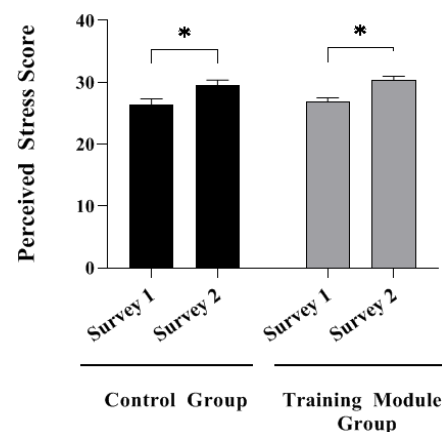


Figure 1. Changes in students' perceived stress during the academic semester. Values are presented as means  $\pm$  SEM. Statistically significant differences ( $P<0.05$ ) between groups are denoted with an asterisk (\*)

Table 1. Changes in Students' Career Readiness Perceptions During the Semester<sup>1</sup>

| Career Readiness Perceptions                                                                                                                 | Control Group   |                 |             | Training Module Group |                 |             | Control vs. Training Module P Value |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------|-------------|-----------------------|-----------------|-------------|-------------------------------------|
|                                                                                                                                              | Survey 1        | Survey 2        | Mean Change | Survey 1              | Survey 2        | Mean Change |                                     |
| I have received sufficient training during my undergraduate program regarding career planning                                                | 5.11 $\pm$ 0.31 | 5.62 $\pm$ 0.30 | +0.51       | 5.15 $\pm$ 0.24       | 6.22 $\pm$ 0.21 | +1.07*      | 0.022*                              |
| I have identified a future career path                                                                                                       | 5.67 $\pm$ 0.40 | 6.24 $\pm$ 0.43 | +0.57       | 5.83 $\pm$ 0.29       | 6.65 $\pm$ 0.27 | +0.82*      | 0.174                               |
| I feel prepared to graduate because I am equipped with knowledge about STEM career opportunities.                                            | 5.47 $\pm$ 0.33 | 5.94 $\pm$ 0.36 | +0.47       | 5.42 $\pm$ 0.23       | 6.59 $\pm$ 0.20 | +1.17*      | 0.065                               |
| I have confidence in my understanding of STEM employment sectors                                                                             | 5.64 $\pm$ 0.30 | 6.06 $\pm$ 0.34 | +0.42       | 6.04 $\pm$ 0.22       | 6.76 $\pm$ 0.19 | +0.72*      | 0.216                               |
| I have confidence in my ability to translate skills developed during my undergraduate program into skills that are relevant in the workplace | 6.23 $\pm$ 0.28 | 6.54 $\pm$ 0.34 | +0.31       | 6.83 $\pm$ 0.20       | 7.57 $\pm$ 0.15 | +0.74*      | 0.210                               |
| I am aware of the types of skills and attributes that are expected in the STEM workplace                                                     | 6.68 $\pm$ 0.29 | 7.05 $\pm$ 0.30 | +0.37       | 6.92 $\pm$ 0.23       | 7.54 $\pm$ 0.17 | +0.62*      | 0.250                               |
| I am confident in my understanding of employer expectations in the STEM workplace                                                            | 6.00 $\pm$ 0.31 | 6.49 $\pm$ 0.31 | +0.49       | 6.18 $\pm$ 0.23       | 6.81 $\pm$ 0.20 | +0.63*      | 0.349                               |
| I feel prepared to meet employer expectations in the STEM workplace                                                                          | 6.11 $\pm$ 0.32 | 6.38 $\pm$ 0.32 | +0.27       | 6.26 $\pm$ 0.24       | 6.72 $\pm$ 0.22 | +0.46       | 0.188                               |
| I have confidence in my overall job readiness                                                                                                | 4.36 $\pm$ 0.32 | 5.31 $\pm$ 0.34 | +0.95*      | 5.22 $\pm$ 0.24       | 6.07 $\pm$ 0.22 | +0.85*      | 0.469                               |

<sup>1</sup>Data are presented as means  $\pm$  SEM. Career readiness perceptions were measured using a Likert scale (1-10), wherein 1 corresponded to "Strongly Disagree" and 10 corresponded to "Strongly Agree". Within each group, statistically significant differences ( $P<0.05$ ) between Survey 1 and Survey 2 responses were determined using a Students t-test and are denoted with an asterisk (\*). Differences in the mean change during the semester (i.e., Survey 2 – Survey 1) between the Control and Training Module Groups are indicated by the P value in the table.

**Table 2. Correlations Between All Students' Career Readiness Perceptions and Perceived Stress<sup>1</sup>**

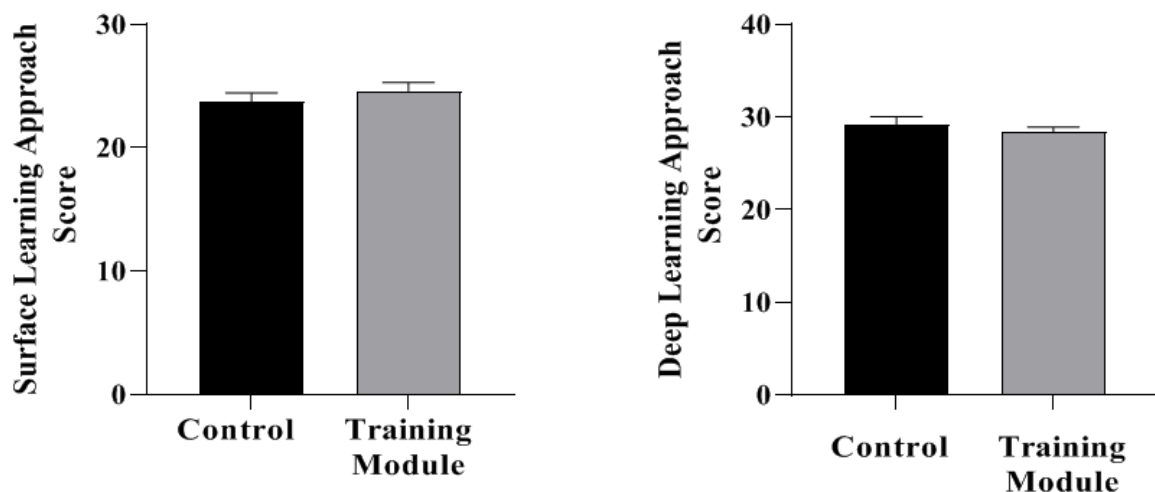
| Perceived Stress Score versus                                                                                                                | Control                     |         | Training Module             |         |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------|-----------------------------|---------|
|                                                                                                                                              | Correlation Coefficient (r) | P Value | Correlation Coefficient (r) | P Value |
| I have received sufficient training during my undergraduate program regarding career planning                                                | -0.089                      | 0.526   | -0.262                      | 0.009*  |
| I have identified a future career path                                                                                                       | -0.146                      | 0.287   | -0.260                      | 0.009*  |
| I feel prepared to graduate because I am equipped with knowledge about STEM career opportunities.                                            | -0.003                      | 0.980   | -0.250                      | 0.014*  |
| I have confidence in my understanding of STEM employment sectors                                                                             | 0.102                       | 0.457   | -0.176                      | 0.084   |
| I have confidence in my ability to translate skills developed during my undergraduate program into skills that are relevant in the workplace | -0.037                      | 0.791   | -0.177                      | 0.084   |
| I am aware of the types of skills and attributes that are expected in the STEM workplace                                                     | -0.122                      | 0.368   | -0.218                      | 0.032*  |
| I am confident in my understanding of employer expectations in the STEM workplace                                                            | -0.005                      | 0.970   | -0.089                      | 0.383   |
| I feel prepared to meet employer expectations in the STEM workplace                                                                          | -0.145                      | 0.286   | -0.172                      | 0.046*  |
| I have confidence in my overall job readiness                                                                                                | -0.158                      | 0.259   | -0.268                      | 0.008*  |

<sup>1</sup>Data are presented as correlation coefficients (r) with their corresponding *P* values. Statistically significant relationships ( $P < 0.05$ ) between each career readiness perception and perceived stress are denoted with an asterisk (\*).

### 3.2. A Deep Learning Approach is Associated with Students' Career Readiness Perceptions

The type of learning approach utilized by students is applied to any learning context, wherein a deep learning approach is characterized by an interest in the task and greater self-regulation, whereas students utilizing a surface learning approach only complete the bare minimum requirements of a task and tend to learn via rote memorization [22]. At the end of the semester, students' learning approach was assessed and there was no difference in either surface or deep learning approach scores between the Control and Training Module Groups ( $P > 0.05$ , Figure 2). Interestingly, the relationships between students' learning approach and their career readiness perceptions differed between the Control and Training Module Group, as shown in Table 3. A deep learning approach was positively correlated with each career readiness perception assessed within the Training Module Group ( $P < 0.05$ ; Table 3), demonstrating the consistent relationship between this engaged learning style and the associated benefits of feeling prepared for the workplace post-graduation. Conversely, in the Control

Group deep learning approach was only positively related to students' i) ability to translate skills acquired in the undergraduate program into the workplace, and ii) overall career readiness ( $P < 0.05$ , Table 3). Collectively, these data emphasize the importance of a deep learning approach for undergraduate students' career readiness, independent of completion of additional targeted career planning training. Conversely, surface learning approaches were negatively correlated with career readiness perceptions, wherein statistically significant negative relationships were apparent for Training Module Group students' i) knowledge of STEM career opportunities, ii) understanding of STEM employment sectors, iii) ability to translate skills into the workplace, iv) feeling prepared to meet employer expectations, and v) overall job readiness ( $P < 0.05$ ; Table 3). Further, in the Control Group these relationships were still negative; however, the only relationship between surface learning approach and career readiness perceptions to reach statistical significance was for students' feelings of being prepared to meet employer expectations in the STEM workplace. This indicates that students with a surface learning approach felt less prepared to meet employer expectations.



**Figure 2.** Changes in students' learning approach scores during the academic semester. Data are presented as means  $\pm$  SEM. Statistically significant differences ( $P < 0.05$ ) between the Control and Training Module Groups are denoted with an asterisk (\*)

**Table 3. Correlations Between Students' Career Readiness Perceptions and Learning Approach<sup>1</sup>**

| Career Readiness Perceptions versus Deep Learning Approach Score                                                                             |                             |         |                             |         |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------|-----------------------------|---------|
|                                                                                                                                              | Control                     |         | Training Module             |         |
|                                                                                                                                              | Correlation Coefficient (r) | P Value | Correlation Coefficient (r) | P Value |
| I have received sufficient training during my undergraduate program regarding career planning                                                | 0.062                       | 0.658   | 0.197                       | 0.049*  |
| I have identified a future career path                                                                                                       | 0.097                       | 0.483   | 0.236                       | 0.019*  |
| I feel prepared to graduate because I am equipped with knowledge about STEM career opportunities                                             | 0.216                       | 0.120   | 0.144                       | 0.158   |
| I have confidence in my understanding of STEM employment sectors                                                                             | 0.230                       | 0.091   | 0.272                       | 0.007*  |
| I have confidence in my ability to translate skills developed during my undergraduate program into skills that are relevant in the workplace | 0.320                       | 0.020*  | 0.267                       | 0.008*  |
| I am aware of the types of skills and attributes that are expected in the STEM workplace                                                     | 0.081                       | 0.548   | 0.239                       | 0.019*  |
| I am confident in my understanding of employer expectations in the STEM workplace                                                            | 0.124                       | 0.362   | 0.399                       | <0.001* |
| I feel prepared to meet employer expectations in the STEM workplace                                                                          | 0.342                       | 0.010*  | 0.327                       | 0.001*  |
| I have confidence in my overall job readiness                                                                                                | 0.268                       | 0.050*  | 0.255                       | 0.011*  |
| Career Readiness Perceptions versus Surface Learning Approach Score                                                                          |                             |         |                             |         |
|                                                                                                                                              | Control                     |         | Training Module             |         |
|                                                                                                                                              | Correlation Coefficient (r) | P Value | Correlation Coefficient (r) | P Value |
| I have received sufficient training during my undergraduate program regarding career planning                                                | -0.048                      | 0.732   | 0.062                       | 0.658   |
| I have identified a future career path                                                                                                       | -0.145                      | 0.290   | -0.114                      | 0.263   |
| I feel prepared to graduate because I am equipped with knowledge about STEM career opportunities                                             | -0.184                      | 0.186   | -0.212                      | 0.037*  |
| I have confidence in my understanding of STEM employment sectors                                                                             | -0.234                      | 0.086   | -0.237                      | 0.019*  |
| I have confidence in my ability to translate skills developed during my undergraduate program into skills that are relevant in the workplace | -0.152                      | 0.276   | -0.237                      | 0.019*  |
| I am aware of the types of skills and attributes that are expected in the STEM workplace                                                     | -0.170                      | 0.206   | -0.073                      | 0.479   |
| I am confident in my understanding of employer expectations in the STEM workplace                                                            | -0.143                      | 0.294   | -0.161                      | 0.113   |
| I feel prepared to meet employer expectations in the STEM workplace                                                                          | -0.289                      | 0.031*  | -0.234                      | 0.020*  |
| I have confidence in my overall job readiness                                                                                                | -0.176                      | 0.208   | -0.299                      | 0.003*  |

<sup>1</sup>Data are presented as correlation coefficients (r) with their corresponding P values. Statistically significant relationships ( $P < 0.05$ ) between each career readiness perception and learning approach (both surface and deep learning approaches) are denoted with an asterisk (\*).

### 3.3. Completion of the Career Readiness Training Modules is Associated with the Development of Core Employability Traits

Students in the Training Module Group found critical elements within the training module beneficial; in particular, 63% of students highlighted the usefulness of training provided for resumé/curriculum vitae development and interview preparation as a key element in the module. Additionally, 51% highlighted the beneficial effect of the training for career planning and/or exploration of career opportunities in STEM, and 43% of students benefited from learning self-promotion strategies within the job market. Further, 72% of students found the self-discovery process through the key employability traits and skills competency assessment beneficial. Identifying and analyzing the diversity of students' learning behaviours and skills represents an integral step in the process of achieving career readiness [23]. In this connection, a component of the online career readiness training required students to conduct a self-assessment of key employability traits and skill competency levels that are relevant for the STEM workplace, as shown in Table 4. Students ranked their capabilities in the moderate to high competency categories for the majority of employability traits and skills. Most students (>85%) had developed high skill competency in oral and written communication, teamwork, organization

and time management, and information literacy (Table 4). Students' competency ranking was equally divided between high (49.5%) and moderate (49.5%) for creativity, which is a relevant skill that can be underappreciated in STEM but is required for problem solving [24].

**Table 4. Frequency of Students' Self-Assessed Core Employability Skills and Traits Competency Level within the Training Module Group<sup>1</sup>**

|                                           | Competency Level Frequency of Core Employability Skills and Traits in STEM (% , n) |           |            |
|-------------------------------------------|------------------------------------------------------------------------------------|-----------|------------|
|                                           | Low                                                                                | Moderate  | High       |
| <b>Inquiry &amp; Analysis</b>             | 0 (0)                                                                              | 27.1 (29) | 72.9 (78)  |
| <b>Problem Solving</b>                    | 0.93 (1)                                                                           | 33.6 (36) | 65.4 (70)  |
| <b>Oral Communication</b>                 | 0 (0)                                                                              | 14.0 (15) | 86.0 (92)  |
| <b>Written Communication</b>              | 0 (0)                                                                              | 10.3 (11) | 89.7 (96)  |
| <b>Reading Comprehension</b>              | 0 (0)                                                                              | 32.7 (35) | 67.3 (72)  |
| <b>Creativity</b>                         | 0.93 (1)                                                                           | 49.5 (53) | 49.5 (53)  |
| <b>Teamwork/Collaboration</b>             | 0 (0)                                                                              | 2.8 (3)   | 97.2 (104) |
| <b>Leadership</b>                         | 0.93 (1)                                                                           | 24.3 (26) | 74.8 (80)  |
| <b>Organization &amp; Time Management</b> | 0 (0)                                                                              | 13.1 (14) | 86.9 (93)  |
| <b>Ethical Reasoning</b>                  | 2.8 (3)                                                                            | 30.8 (33) | 66.4 (71)  |
| <b>Information Literacy</b>               | 0 (0)                                                                              | 8.4 (9)   | 91.6 (98)  |

<sup>1</sup>Self-assessed core employability traits and skills competency level were measured using a Likert scale (0-4) indicating low, moderate or high competency levels. Frequency of students within each competency category (% and n) are shown.

Table 5. Correlations Between Students' Undergraduate Core Employability Skills and Learning Approach within Training Module Group<sup>1</sup>

| Core Employability Skills and Traits versus | Learning Approach            |         |                             |         |
|---------------------------------------------|------------------------------|---------|-----------------------------|---------|
|                                             | Surface Learning Total Score |         | Deep Learning Total Score   |         |
|                                             | Correlation coefficient (r)  | P Value | Correlation coefficient (r) | P Value |
| Inquiry                                     | -0.245                       | 0.014*  | 0.452                       | <0.001* |
| Problem Solving                             | -0.157                       | 0.118   | 0.430                       | <0.001* |
| Oral Communication                          | -0.122                       | 0.225   | 0.306                       | 0.002*  |
| Written Communication                       | -0.075                       | 0.459   | 0.162                       | 0.106   |
| Reading Comprehension                       | -0.120                       | 0.230   | 0.420                       | <0.001* |
| Creativity                                  | -0.115                       | 0.252   | 0.311                       | 0.002*  |
| Teamwork                                    | -0.008                       | 0.936   | 0.189                       | 0.058   |
| Leadership                                  | -0.104                       | 0.302   | 0.469                       | <0.001* |
| Organization & Time Management              | -0.312                       | 0.002*  | 0.422                       | <0.001* |
| Ethical Reasoning                           | -0.270                       | 0.006*  | 0.416                       | <0.001* |
| Information Literacy                        | -0.082                       | 0.413   | 0.264                       | 0.008*  |

<sup>1</sup>Data are presented as correlation coefficients (r) with their corresponding P values. Statistically significant relationships ( $P < 0.05$ ) between core employability skill or trait and learning approach (both surface and deep learning approaches) are denoted with an asterisk (\*).

### 3.4. A Deep Learning Approach is Associated with the Development of Core Employability Traits

Students' perceived development of undergraduate core traits and STEM employability traits were consistently related to their learning approach. Specifically, a higher surface learning approach was negatively correlated with the perceived development of all core employability traits and skills assessed, whereas a higher deep learning approach was positively correlated with the perceived development of core employability traits and skills (Table 5). Of these employability traits and skills, perceived development of inquiry, organization and time management, and ethical reasoning were significantly and negatively correlated with higher surface learning scores ( $P < 0.05$ , Table 5). Conversely, and consistently, higher deep learning approach scores were positively correlated with higher perceived competency for all employability traits assessed ( $P < 0.05$ ; Table 5) with the exception of written communication and teamwork, which did not reach statistical significance. Therefore, a deep learning approach is associated with the perceived development of several key employability traits, which indicates that students with higher engagement and greater self-regulatory capabilities (key elements of a deep learning approach) perceive themselves to exhibit higher competency for many key employability traits [25,26].

## 4. Discussion

It has been recommended that career readiness training urgently needs to be implemented into undergraduate programs in order to provide students with the opportunity to develop skills sought after by employers, to learn how to translate those skills into the evolving occupational landscape, and improve overall career readiness [8]. Career readiness research is an emerging field aiming to close the growing gap in expectations between employers seeking job-ready graduates and the higher education institutions that train those graduates [27]. New graduates transitioning from higher education into the workplace require core transferable skills, including but not limited to: problem solving, critical thinking, scientific literacy, and collaboration [4,19,20,28,29]. Recent research indicates that graduates may be either lacking the core

competencies that employers seek [27] or that a perceived gap in skills is created by both graduates and employers being underinformed about what skills are developed upon the completion of a degree program [30]. Development of these skills can be limited for many university graduates; therefore, institutions are addressing this professional and transferable skill gap by redesigning the curricula to promote and centralize development of these career skills [6]. Programs with a career preparation component (e.g., focusing on workplace preparation while concomitantly granting course credit towards program requirements) have reported higher graduation rates, lower overall credit hours to earn a degree, and higher levels of academic performance amongst enrolled students [7]. Previous research has reported a positive correlation between an individual's perceived employability and well-being, indicating that career readiness training may be important for improving individuals' mental health [31]. The objective of this study was to determine if career preparation content, such as engagement with an optional career readiness training module, can influence students' career readiness perceptions and associated stress.

Although the effectiveness of career planning courses for general undergraduate students has been studied [32,33], career readiness studies conducted within STEM-specific undergraduate student populations are less frequent [34,35] and should be investigated to develop STEM-specific training initiatives [34]. In line with this suggestion, our study demonstrated that students who completed the online career training course perceived they had received sufficient career planning training in their undergraduate program compared to Control Group (Table 1). Moreover, students in the Training Module Group reported improved career readiness perceptions related to career path identification, knowledge of STEM career opportunities, ability to translate skills into the STEM workplace, understanding of STEM employment sectors, understanding of employer expectations, and the ability to meet those employer expectations, whereas the change in these perceived capabilities was not statistically significant in the Control Group (Table 1). Although students in both the Control and Training Modules Groups reported increased confidence in their perceived overall job readiness, the level of confidence was higher in the Training Module Group at the end of the semester (i.e., on Survey 2) and initial confidence scores in both groups were low. The improvements in perceived career readiness

in the Control Group indicates that undergraduate students are still receiving career preparation information from other sources (formal and informal in nature, such as in courses, extra-curricular clubs or student associations and information sessions), which is positive, as this is an identified training need in STEM. [2,34,35]. Thus, the improvements in perceived career readiness in the Training Module Group cannot be exclusively attributed to the online career readiness training resource; however, a multi-faceted approach that includes the online career readiness training resource, along with other career preparation information sources undergraduate STEM students are exposed to may be the most effective training approach. Previous studies have shown that in over 90% career preparation courses there is a positive impact on students' career thoughts, vocational identity, and career decision-making capabilities [7], and similar outcomes were apparent following the completion of the online training course in this study. Further, enrollment in career planning courses in higher education has been shown to increase retention of students in the program and higher graduation rates, indicating the importance of connecting academic programs to post-graduation career directions [7,33,36], thereby demonstrating the importance of inclusion of formal career preparation training in undergraduate education.

Students' stress levels have the potential to modify either their engagement with career preparation training or their overall career readiness. Academic stress in students has been shown to increase anxiety, reduce satisfaction and enjoyment of courses, and negatively affect academic achievement [37,38,39]. As this research was conducted during the COVID-19 pandemic, it is important to note that the greatest stress levels have been reported to impact individuals between 18 to 24 years of age, wherein pandemic-associated stress levels were significantly prevalent amongst this age group [40,41,42]. Therefore, the COVID-19 pandemic has resulted in increased student anxiety and stress [43-49], feelings of uncertainty regarding future courses, and importantly, career prospects [50,51].

Greater perceived employability has been shown to be positively correlated with individual well-being [31] and may be associated with lower stress, more effective career-planning behaviours, and more engagement among students [9]. One consequence of the COVID-19 pandemic is that fewer graduates during this period experienced employment stability [9]. Given that one's career is a source of identity establishment and self-esteem, pandemic-associated unemployment has been shown to be a significant source of stress among young people [52]. In the current study, students' overall perceived stress scores (including both academic and non-academic sources of stress) increased during the semester, but the level of stress reported was not different between the Control and Training Module Groups (Figure 1). Interestingly, the level of stress reported in this study was similar to pre-pandemic stress scores reported in medical, nursing, and pharmacy students (i.e., 28-29 out of 56) [53], which is not indicative of elevated perceived stress levels [21]. Correlative analyses determined an inverse relationship between students' stress levels and the various elements of career readiness, which included identification of a future

career path, knowledge of STEM career opportunities and expectations, feeling prepared to meet STEM employer expectations, and confidence in overall job readiness for the participants in the Training Module Group (Table 2). These relationships were not observed in Control Group. Thus, students with higher career readiness perceptions associated with being prepared to enter the STEM workforce had lower stress. The inverse relationship between perceived employability and perceived stress has been reported elsewhere [9]. These findings are similar to previous studies reporting higher academic stress, decreased career readiness, and feeling less acquainted with post-graduation career opportunities [17].

Learning approach is a product of the interaction among many factors, such as a students' engagement with an assigned task, their preferences for a particular learning style, preexisting knowledge of the content, and environmental factors such as, but not limited to, the instructors' teaching approach [22]. Typical traits of students utilizing a deep learning approach include higher engagement with their learning, self-regulation, interest in course concepts or an assigned task, and the ability to use their time more efficiently [22,54]. Conversely, students with a surface learning approach only complete the bare minimum requirements of a task and tend to learn via rote memorization [22]. There was no difference in either surface or deep learning approaches, between students in the Control and Training Module Groups (Figure 2), indicating that there was no preferred learning and engagement approach utilized in either group. Interestingly, the overall learning approach implemented by students was related to their career readiness perceptions (Table 3). A deep learning approach was positively associated with all of the career readiness perceptions assessed in the Training Module Group, thereby demonstrating the value of higher engagement with students' preparation for entry into the workplace post-graduation. Conversely, the only significant relationships between a deep learning approach and career readiness within the Control Group was for students' confidence in the ability to translate skills developed in their undergraduate program into the workplace, feeling prepared to meet employer expectations, and their overall feelings of career readiness. Thus, in the Control Group, without completing additional career preparation training the students that were utilizing a deep learning approach exhibited higher degrees of career readiness perceptions in three critical areas, which was not apparent in students utilizing a surface learning approach (Table 3). The relationship between surface learning approaches and career readiness exhibited almost exclusively negative relationships. Within the Training Module Group higher surface learning approach scores were consistently associated with feeling less prepared to graduate because of knowledge level about STEM career opportunities and lower confidence in their i) understanding of STEM employment sectors, ii) ability to translate skills developed in undergraduate program to the workplace, and iii) lower overall job readiness. Students in both the Control and Training Module Groups exhibited the same relationship between higher surface learning approaches and lower preparation to meet employer expectations in the STEM workplace. These findings indicate that surface

learners perceive themselves to be less prepared for STEM career directions. Collectively, these results indicate that critical aspects of career readiness are improved in students who take a deeper approach to learning and highlight the significance of students' learning approach in influencing their preparation for the next stage of employment post-graduation. Further, these results highlight the importance of promoting a deeper learning approach, not only for promotion of engagement and understanding of course or program content [22] but also to support elements of career preparation prior to completing their undergraduate program.

Identifying and analyzing the diversity of students' learning behaviours and skills represent integral steps in the process of achieving career readiness [23]. The development of employability traits plays an integral role in employee recruitment [55], as there are identified limitations in the number of qualified individuals needed to fill positions within the STEM field, which has driven higher education institutions to develop STEM recruitment and retention programs [56]. Promoting employability has become increasingly important within undergraduate STEM education, as reports exist of employer dissatisfaction with students' workplace skills, self-management and independence, problem solving, leadership competency, and communication skills [2,57]. In this study, within the career readiness training resource modules, students provided a self-assessment of their capabilities with respect to key employability traits and skills. Students reported high self-assessed capabilities (i.e., >85% of students) for the employability traits of oral and written communication skills, teamwork/collaboration, organization and time management and information literacy (Table 4), which are among the key employability traits prioritized by employers [58]. Collaboration and communication skills are employability skills highly sought by employers [8,19,29,59]. Oral communication skills are consistently identified as a key soft skill that is lacking for employment [59,60,61] and written communication skills are required to adapt writing styles based on context and the type of workplace or field [62]. Teamwork promotes job readiness and personal benefits, like self-discovery and the development of genuine relationships [63] and as a highly sought-after employability skill in STEM graduates [64,65], effective collaboration is a central component of overall professional behaviours [66]. Organization and time management skills are not only key employability traits but are also associated with increased academic performance and decreased anxiety levels in students [67]. Additionally, information or scientific literacy is an essential component of a STEM graduate's skillset that is among the highly sought-after skills by employers [68] and has utility beyond the scope of STEM professions, wherein it provides individuals with the means to critically appraise information and apply quantitative reasoning [69,70]. The employability traits that students assessed themselves to have moderate competency levels or had a lower frequency of students expressing high confidence in their capabilities (i.e., between 49.5% to 74.8% of students) included leadership, problem solving, creativity, inquiry and analysis, reading comprehension and ethical reasoning (Table 4). Leadership skills

represent a critical basic employability trait that is valued by human resource managers; however, graduates have been shown to overestimate the leadership training they receive in higher education [68]. Problem solving has been identified as a highly in-demand skill within the STEM field, wherein jobs request this skill at a rate that is 75% higher than non-STEM positions [59]. In this connection, employer demands for job candidates exhibiting creativity competency has increased as the value of utilizing creativity to solve problems becomes more relevant [67,71,72,73]. Another skill related to problem solving competency is inquiry, which is the ability to harmonize existing knowledge with inquisitive skills to find solutions to problems [74,75,76]. Further, reading comprehension is integral for both undergraduate education and career success, as it connects language and thought processes [77] and has been shown to be a predictor of academic success in undergraduate students [78,79]. Finally, development of ethical reasoning competency in higher education has been identified as a crucial skill for real-life situations wherein students will be challenged to make ethical decisions both inside and outside of the workplace [80]. To foster the growth of relevant career readiness competencies, higher education must give consideration to students' learning approaches [23]. Interestingly, in the current study, students utilizing a deeper learning approach had greater confidence in their development of the aforementioned critical employability skills in STEM and their preparation for entry into the workplace (Table 5). This is in agreement with findings that students exhibiting greater deep learning approach scores are associated with having excellent organizational skills and time-management capabilities. [81] Conversely, in the current study, utilization of a surface learning approach was negatively related to students' perceived abilities in inquiry, organization and time management, and ethical reasoning (Table 5). Collectively, this data highlights the importance of learning approach and engagement for the development of key employability skills in undergraduate education.

The self-assessment of key employability traits and skills were part of the career readiness training resource modules and were only assessed at one time point (i.e., during the completion of the training module), and therefore, these data are only available in the Training Module Group. This represents a limitation in this study, as there is not data available to measure either the changes in the development of these skills over time or the ability to compare students' self-assessed skill competency between the Control and Training Module Groups, which should be assessed in future studies. Additionally, self-assessments can result in students either inflating or underestimating their capabilities; however, despite this inherent source of error, students should be encouraged to critically reflect and evaluate their skill competency to develop accurate perceptions of their own capabilities and performance, which is a process repeated throughout their working lives [58]. Further, the results of the current study were only assessed within the context of students enrolled in a fourth-year nutritional science course, which may limit the extrapolation to the larger STEM major undergraduate student population. Thus, a broader assessment of students' career readiness perceptions across multiple STEM majors that utilizes a larger sample

size would be of interest. The career readiness training resource modules are available online to all students within the College; therefore, assessing the impact of this training resource on students from different STEM majors and at different stages of their undergraduate program could help optimize the impact of this training to help support students' post-graduation career preparation. Further, assessing development of key employability skills and traits longitudinally over the duration of an undergraduate program (i.e., first year versus fourth year) would provide an index of the effectiveness of STEM programs in addressing career preparation and would provide critical insight for program evaluation. Although the training resource is freely available to all undergraduate students, the level of engagement with the training resource outside of its inclusion in an optional course assessment is unknown, and so this may represent an under-utilized training resource. Finally, since some career readiness perceptions were increased within the Control Group, it will be important to assess the additional career preparation resources that students are accessing in order to develop a training strategy that optimizes existing and additional and/or alternative training resources to support undergraduate STEM students in the critically identified area of career preparation [2,6,8,34,35].

## 5. Conclusion

Collectively, the results from the current study demonstrate the usefulness of a career readiness training resource in STEM, wherein undergraduate programs may have more required courses and fewer elective opportunities to include a discipline specific career readiness course formally (i.e., for credit) into the program. Therefore, having supportive career preparation resources available to students in addition to their program requirements provides a viable option in STEM, although efforts to increase students' awareness of the resources and promote their engagement would be required. Career preparation training and awareness of competency levels of critical employability skills are useful to students to identify areas for further development on an individualized basis with the intent of addressing the skills gap between STEM programs and employer expectations. The current study demonstrated that students' who completed the online career training module indicated that they believed they had received sufficient career planning training compared to students in the Control Group (Table 1). Importantly, the current study demonstrated the relationship between career readiness perceptions and learning approach, wherein students' utilizing a deep learning approach felt more prepared for post-graduation career next steps (Table 3), which may include additional education at the graduate or professional school level or entry into the workforce in STEM careers, and higher competencies in core employability traits (Table 5). In contrast, students utilizing a surface learning approach was related to lower career readiness perceptions and competencies in core employability traits, which was reflective of the cumulative impact of a surface learning approach throughout an undergraduate program that was now translating into real world consequences wherein

students felt less prepared. From an instructional perspective this highlights the necessity of fostering STEM students' deep learning approach throughout the program, which can be directly translated into preparation for post-graduation success in STEM careers. Additionally, the negative impact of the COVID-19 pandemic on students' anxiety and stress levels [43-49] combined with the feelings of uncertainty about career prospects [50,51] and lower post-graduation employment stability [9] highlight the importance of considering stress on key educational outcomes, including career readiness. As such, students with lower stress levels exhibited higher confidence in their career readiness perceptions (Table 2). Combined, an education approach to promote deeper learning and attenuate stress may directly address the skills gap identified in STEM [2]. Further research is required to identify specific educational approaches and novel ways to promote development of the key employability skills and traits (sometimes referred to as soft skills) in STEM that can be integrated into programs. As STEM education shifts to accommodate more applicable practices in response to the soft skills gap in the STEM field, it is important to include career preparation content early within the undergraduate degree program.

## Acknowledgements

T. S. is supported by a University of Guelph Presidents' Scholarship. D. M. B is supported by a Scholarship of Teaching and Learning Graduate Research Assistantship from the College of Biological Sciences at the University of Guelph. J. L. A. M. is supported by a graduate scholarship from the Canadian Institute of Health Research.

## Statement of Competing Interests

The authors have no conflicts of interest to disclose.

## Abbreviations

Science, Technology, Engineering and Mathematics (STEM); Revised Study Process Questionnaire (RSPQ-2F); Perceived Stress Scale (PSS); College of Biological Science (CBS).

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