

# The Effect of a Face-To-Face ScienceReady Preparatory Short Course on University Students' Self-Efficacy

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## Abstract

The ScienceReady preparatory course is an intensive study designed to improve beginning university undergraduate students' understanding of medical/scientific concepts, and reduce their anxiety about studying the science component of their enrolled programs. Its goals are to stimulate students' science curiosity and provide the fundamental scientific content they are expected to know and build further on the knowledge that will feature in their upcoming programs.

This article aims to describe the ScienceReady course, discuss the impact of the course on the participants, determine the relationship of the course with self-efficacy, and explain the implications of the results.

Students were tested before and after the course to ascertain whether it increased or decreased or not affected self-efficacy. The results of the pre- and post-test surveys were unequivocal. The majority of the individual items for the self-efficacy questionnaire showed a significant increase in self-efficacy post-course.

**Keywords:** Self-efficacy; health science students; university study; preparatory science course.

## Introduction

It is widely accepted that university students undertaking science-based programs are confronted by various educational challenges (Penman & Thalluri, 2014; Sturges & Maurier, 2013). Many incoming first-year health-science program students transition to university study from non-traditional backgrounds and have diverse equity characteristics. Students' poor course performance is often linked with issues related to self-confidence, study skills and/or inadequate science background. Poor performance results in delayed academic progress and/or withdrawal from the program altogether (Thalluri & Penman, 2019; Baik et al., 2015). Preparatory science courses have been used to help students prepare for the science component of their courses (Schmid et al., 2012).

To assist students, the health science division of a South Australian metropolitan university developed and implemented the ScienceReady course. Once the first year university offers are made, all incoming allied health science program students were informed via email and directed to the ScienceReady short course website where information about the curriculum and who may benefit attending the course (e.g. students with no/little science background, students who have not been in the education system for a long time, students whose English is a second language, students who are anxious about going to university study,



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first generation going to university study). A majority of students who enrolled in this course fell into one or more these categories (Thalluri, 2016).

Evidence from student evaluations noted that students who participated in this short course felt better prepared for their undergraduate study (Thalluri, 2016), with a reduced attrition rate and higher academic results in their first year science courses in cognate courses. Results from previous surveys revealed that students' confidence and belief in their capabilities seemed to have improved following their participation (Thalluri, 2016). This belief and increased confidence in one's ability to achieve a goal or goals is known as self-efficacy. Thus, in the latest offering in 2019, the participants' self-efficacy was determined before and after the short course to confirm the effect of the course on this belief on one's abilities.

Originally called 'Preparing for Health Sciences', later changed to 'ScienceReady', our optional short course has been running on-campus at a South Australian university for over two decades. The course, offered face-to-face, aims to provide students with the essential academic skills, assumed scientific knowledge, social networking and interaction to assist with the smooth transition to first year university studies when commencing any of the university's health science undergraduate programs, such as Exercise and Sports Science, Health Science, Human Movement, Laboratory Medicine, Medical Radiation Science, Medical Sciences, Midwifery, Nursing, Nutrition and Food Sciences, Occupational Therapy, Pharmaceutical Sciences, Pharmacy, Physiotherapy and Podiatry.

Once students were offered a place for one of the above undergraduate degrees at the university, they were informed about this short course by the marketing staff. Based on their background and needs, students assess and decide if they wish to attend the fee-paying (nominal fee approximately \$10(AU) per hour), optional ScienceReady short course. A description of the ScienceReady preparatory science course is first provided in this article, followed by the significance of self-efficacy, then a discussion of the impact of the preparatory course on the participants, including its association with self-efficacy.

### ***ScienceReady Course Description***

The short course is a four, full-day intensive study conducted before the orientation week, which happens a week before the start of the semester. It is recommended for students who want a head-start to university. As mentioned in the introduction, students who have not been in the education system for some time, or have not studied a science subject in their secondary education will benefit from the course. In addition, it is suggested for students who wish to improve their understanding of medical/scientific concepts, need help in understanding medical terminology, are anxious about studying the science component of their enrolled program, and/or whose English is a second language and may be English deficient.

The course, as an educational intervention, affords an overview of the basic scientific concepts and principles, and is delivered through a series of live interactive lectures and laboratory activities, which includes visits to anatomy, physiology, biosciences laboratories and pathology museum. The goals are to stimulate students' curiosity levels and provide the fundamental scientific content they are expected to know and build further on the knowledge that will feature in their upcoming enrolled programs. The topics covered during the course are comprehensive including: study skills; essential human anatomy and physiological concepts; relevant biology, chemistry, physics principles that underpin health science courses; introduction to medical, anatomical and scientific terminology; organisation of the human body; body systems and how they work and interact with each other; and the clinical usefulness and applications of biosciences.

The objectives of the course include to (i) learn essential assumed and foundational knowledge to undertake their health science degree, (ii) become orientated to Moodle, the online learning management system and platform for lectures, tutorials, and discussion forum, (iii) gain confidence in approaching science subjects, (iv) experience lectures, (v) gain basic academic skills, such as study, research and writing skills, (vi) conduct laboratory experiments and view human models and specimens, (vii) meet and interact with some course coordinators, program directors and student advisors/counsellors, (viii) meet and make acquaintances with fellow students with similar interests and background prior to beginning their degrees; and (ix) share 'Unilife' experiences and become familiar with the university and its facilities. Course evaluations are undertaken to determine whether these objectives have been achieved and highly satisfactory evaluations have been received consistently. For example, in the recent course evaluation, when asked 'Overall, I was satisfied with the quality of this short course', 86% students strongly agreed and 14% agreed to this statement (n= 21, 45.6% response rate).

Post-course evaluations revealed that there were clear perceived improvement in student preparation and confidence, and reduced anxiety levels prior to starting first year university (Thalluri, 2016). It was also shown that students who did the short course gained invariably better academic grades across the science courses in the first year compared to students who have not undertaken the course. However, the effect on the short course on participants' self-efficacy was not measured in previous evaluations.

### ***The Significance of Self-Efficacy***

Self-efficacy is the belief that individuals have the abilities to meet the challenges that confront them and so complete tasks successfully (Akhtar, 2008). It is the overall notion of the individual's perceived abilities to succeed. It extends to mean the self-generated thoughts, feelings, and actions that are systematically designed to impact on learning (Schunk & Zimmerman, 2007). Others view it as a strategy for achieving one's goals, such as successful learning of a science subject and/or completion of a degree at university, thus, the so-called academic self-efficacy (Ackerman, 2020).

Bandura's theory explains how self-efficacy develops (Bandura, 1999). There is a mechanism that plays a crucial role in triggering the belief that people have to succeed and influence their lives significantly. In confronting challenges, Bandura proposed that individuals' perceived self-efficacy influences their coping behavior, and how much effort is needed to accomplish one's goals (Bandura, 1999; Kolbe, 2009, cited in Lopez-Garrido, 2020). It is a self-sustaining trait that develops when a person is driven to work through their problems on their terms, gain success and positive experiences, which in turn enhance further development of self-efficacy.

There are four primary sources of self-efficacy (Hopper, 2019). The so-called mastery experiences refer to performing a task successfully, while social modelling pertains to witnessing other people completing a task, which strengthens the sense of efficacy. Other sources are social persuasion when the individual is made to believe that he/she has the abilities to succeed, and psychological responses, which relate to the emotional states and physical reactions that could influence the belief to succeed (Cherry, 2020). Through a variety of activities, our ScienceReady program endeavoured to provide each of these sources of self-efficacy.

Below are examples of excerpts from students illustrating readiness and confidence in commencing their first year university study after participating in the course:

I really enjoyed meeting some of the lecturers, and getting a taste of what is to come for the year ahead. I feel calmer and more confident to commence with my studies, the study tips, gave me a good basis to launch my studies on the right path. (Student 6 additional comment, 2019)

This course allowed me to learn a significant amount of information about the human body, such as the various systems, their functions and medical terminology. I was able to grasp some fundamental concepts in a short space of time. I feel as though this course has given me a solid foundation to build on and confidence in my ability to learn'. (Student 22 additional comment, 2019)

General self-efficacy can be measured by utilising scales and questionnaires; the most popular is the General/Generalized Self-Efficacy Scale (Ackerman, 2020). The New General Self-Efficacy Scale, developed by Chen, Gully, and Eden (2001), is composed of only eight items, rated on a scale from 1 (strongly disagree) to 5 (strongly agree). The latter questionnaire was used for our purpose.

Increasing self-efficacy of students has many benefits (Ackerman, 2020), however, aiding students' performance has been most important for students because this will ensure they succeed in their courses and complete the program in the long run. A plethora of positive outcomes are as follows: high optimism, enthusiasm, coping and commitment and better academic performance; more effective personal adjustment; better coping mechanisms for stress; better health, and higher overall satisfaction and commitment to remain in school (Chemers et al., 2001; Margolis & McCabe, 2006). Hence, it is imperative to examine how universities and staff can most effectively boost students' self-efficacy and this is what the initiative strived to achieve for the participants.

As defined previously, self-efficacy is the notion of one's capability to accomplish a task or activity and achieve success in it (Bandura, 1997). This positive expectation of being successful in the short course could catalyze the development of self-

efficacy and ultimately lead to a successful science university experience. It is theorised that the students' eagerness to succeed in their studies propelled them to work for their interest and welfare, and thus, develop self-efficacy further.

## Methodology

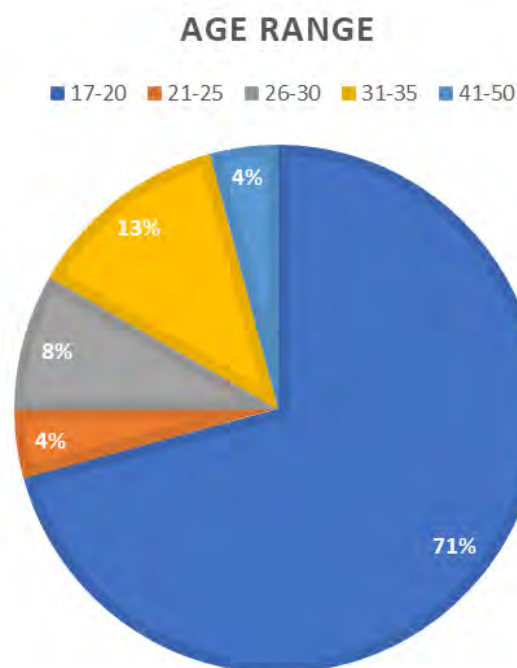
### Research Sample

In the absence of any precedent in the literature, a power of 80% and an alpha ( $\alpha$ ) level of 5% was used to calculate that a sample size of 30 people ( $f = 0.69$ ) (Cohen's  $d = 0.8$ ) would be required to be adequately powered. All students ( $n=64$ ) who were enrolled in the short course in 2019 were invited to participate in the self-efficacy pre- and post-course surveys. Of the 64 students, 78% were women, 36.8% were first members in the family to attend university and 74% identified themselves as having little or no science background. Also, 8% of the participants came from non-English speaking backgrounds.

Fifty-five students completed the survey before the course using pseudonyms. Of those, 33 students (60% return rate) responded to the post-course survey, however, only 24 students used the same pseudo name, which allowed for pair-matching. These 24 students constituted the study cohort for data analysis. The students' demographic characteristics (i.e. age range) are shown in Figure 1.

**Figure 1**

*Student Age Distribution*



### Research Design

A validated instrument called the New General Self-Efficacy Scale (Chen et al., 2001) was used to determine the effect of the intervention (short course) on the development of self-efficacy. Students' self-efficacy was tested before and after the educational intervention. Specifically, the design determined whether it increased or decreased or not affected self-efficacy. In the survey, the Likert-type questions covered various aspects of self-efficacy. See *Appendix 1*.

### ***Ethical Considerations***

Approval from the university ethics committee was obtained before the conduct of the study. The participants were informed about the voluntary nature of their participation in the surveys and were assured of the confidentiality of the information provided. Participation in the surveys was taken as consent.

### ***Data Collection***

Staff members who were not directly involved in organising and running the course conducted the surveys. All students who attended the face-to-face ScienceReady short course were invited to complete the self-efficacy questionnaire at two time points. The first online survey questionnaire link was sent to all students enrolled in the course three days prior to starting of the course and this survey was closed the evening before starting the course. The second survey questionnaire link was sent to students the day after completion of the course and was left opened for two weeks after the course completion.

The participants were informed about the purpose of the study, procedures involved in the study, possible benefits and risks, and their exact involvement. Confidentiality and anonymity were ensured as no actual names were required. It was also explained that general self-efficacy related to the individuals' estimate of their overall ability and confidence to perform successfully in a wide variety of situations, linking the concept to the science course they were about to undertake and/or just completed.

The brief survey was accompanied by a measure in the SPARQTools.org Measuring Mobility toolkit, which provided curated instruments for assessing self-efficacy for selecting the most appropriate measures for the course. There were eight items and five graded measures: 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree (Chen et al., 2001). To calculate the total score for each participant, the average rating of the items is computed by adding respondents' answers to each item and dividing this sum by the total number of items.

### ***Study Measures***

Self-efficacy was measured by the eight-item Likert-type scale (Elaine & Seaman, 2007; Schneider et al., 2016). Participants were asked to rate their agreement with each item on a five-point scale that included: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree. Rating score was 1-5 with the highest score corresponding to strongly agree.

### ***Statistical Analysis***

Data analyses were performed using SPSS version 25.0 (SPSS, Inc., Apache Software Foundation, Chicago, IL, USA). Rating of their agreement with each item for the pre- and post-course were evaluated for the significance of difference using the non-parametric Wilcoxon signed-rank test for hypothesis testing of repeated measurements on a single sample (Sheskin, 2004). Within-group comparison (pre- and post-course overall scores) was also performed using the non-parametric Wilcoxon signed-rank test. A paired sample t-test was not possible due to the non-parametric nature of the data. A non-parametric test (Wilcoxon signed-ranked test) was therefore selected as it provided fewer assumptions about the distribution of responses among the students using these scales. The critical level of significance for statistical testing was set at 0.05 (5%).

## **Results**

This section covers the survey participation, characteristics of the study population, and the results and analysis of the statistical self-efficacy test.

### ***Student Characteristics***

The majority of the participants (71%) belonged to the 17-20 years age range, followed by 13% in the 31-35 age range. Only 4% of the sample belonged to the 41-50 years age range. See Figure 1.

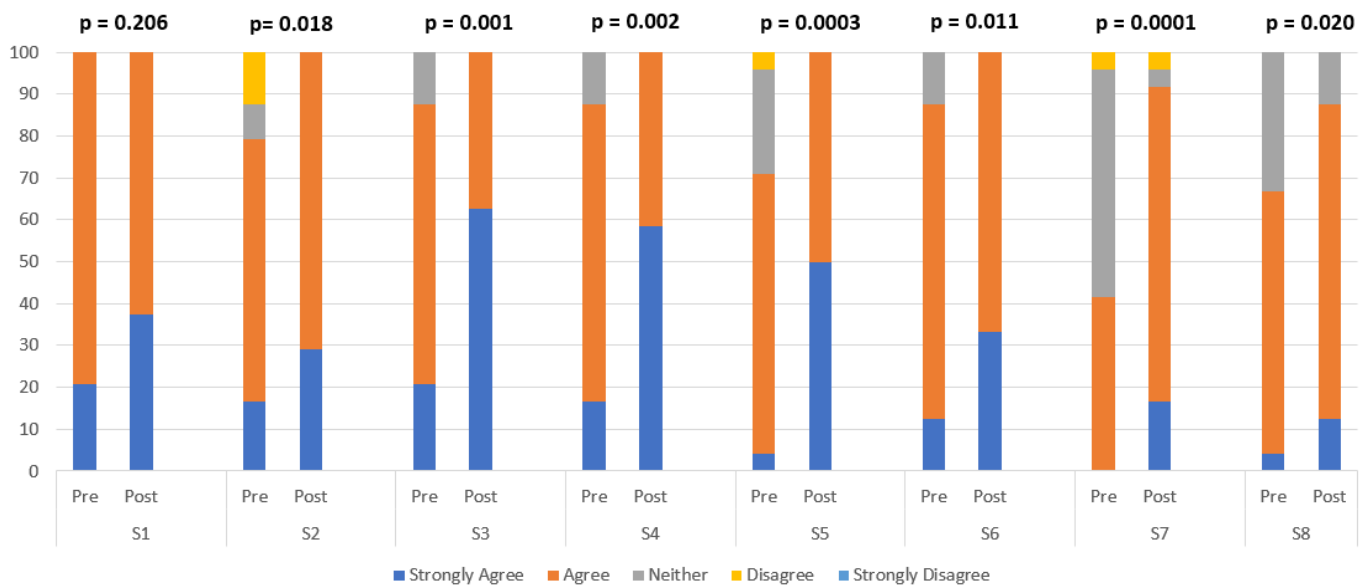
### ***Self-Efficacy Measurement***

Using the Wilcoxon signed-rank test, Figure 2 illustrates the percentage of in pre- and post-course questionnaire. There was no significant difference in agreement with the first statement: "I am able to achieve most of the goals that I set for myself" ( $p=0.206$ ). From statements 2 to 8, there were significantly higher proportions of students agreeing with the following statements: "When facing difficult tasks, I am certain that I will accomplish them" ( $p=0.018$ ), "in general, I think that I can obtain outcomes that are important to me" ( $p=0.001$ ), "I believe I can succeed at most any endeavour to which I set my mind" ( $p=0.002$ ), "I will be able to successfully overcome many challenges" ( $p=0.0003$ ), "I am confident that I can perform effectively

on many different tasks” ( $p=0.011$ ), “compared to other people, I can do most tasks very well” ( $p=0.0001$ ), and “even when things are tough, I can perform quite well” ( $p=0.020$ ). When comparing the overall self-efficacy scores from the questionnaires given pre-course to the overall self-efficacy given post-course, there was a statistically significant difference in the scores ( $p<0.01$ ). Figure 3 shows the mean responses of individual Likert scores. The mean responses in the post-course survey are above that for all mean responses in the pre-course survey.

**Figure 2**

*Percentage of Agreement and Statistical Analysis in Pre- and Post-course Questionnaire*



**Figure 3**

*Mean Responses for all Individual Likert Scores in the Pre-Course and Post-Course Survey*



## Discussion

Previous evaluations of the course ScienceReady indicated that student anxiety levels starting first year university decreased significantly, the student retention rate was higher, and students performed academically significantly better than students who have not done the short course. Students reported consistently high levels of satisfaction with the preparatory course (Thalluri, 2016; Thalluri & Penman, 2019). Another achievement it could account for is boosting students' self-efficacy. This is because following the statistical analysis of the impact of the face-to-face ScienceReady short course on students, it was found to be significantly associated with the increase in the participants' self-efficacy.

This study demonstrated a statistically significant increase in self-efficacy after the participants attended the science short course ( $p < 0.01$ ). When each individual item was statistically investigated, this outcome was especially evident in statements two to eight ( $p < 0.05$ ). The mean response values to the self-efficacy questionnaire were relatively high before the on-campus course. For example, the mean responses in "before the course" self-efficacy questionnaire for "strongly agree" and "agree" were 12% and 65.6%, respectively. The high starting level of self-efficacy may reflect various influences, including academic background, parental support, and attainment of previous goals. Following the course, the mean response in "after the course" self-efficacy questionnaire for "strongly agree" increased by more than three folds (37.5%). The mean response for "agree" after the course remained comparable to the "before the course" mean response. This result is due to a significant increase in the "strongly agree" category. Likewise, "neither agree nor disagree" significantly decreased from 19.8% to 2% in the "after the course" mean response. Overall, this showed a significant and meaningful improvement in self-efficacy. This observation is also consistent with the previous results of course evaluations.

A positive outcome from participating in ScienceReady was the substantial change in the responses that indicated higher self-efficacy for all students completing the program. The result was consistent for these students and the increase pre- to post-course was meaningful considering the lines connecting average response scores pre- and post-course were significantly different. As depicted in Figure 3, the participants were more certain about their belief and confidence in themselves. The changes in their self-appraisal indicated that they believed they would accomplish difficult tasks, achieve important outcomes, and succeed in their endeavors. They were confident that they could overcome many challenges successfully, perform effectively, do most tasks well, and even perform well despite challenging circumstances. All these scale items contribute to the self-efficacy score, which was a measure of the effectiveness of the course.

A contributing factor to the non-significant relationship (statement 1) or modest change in self-efficacy could be that these students were already goal-orientated as indicated by enrolling themselves in the course. Additionally, the students might have started the course with multiple factors that could have an influence on their goal-setting, e.g. academic background and attainment of previous goals. It is therefore expected that there would be minimal differences in their goal achievement after the course. Nonetheless, it is evident from Figures 2 and 3 that students showed markedly increased self-efficacy following their participation in the short course. In other words, this analysis suggests that the content and delivery of the course achieved a significant increase in self-efficacy for the health science beginning students.

The ScienceReady short course had strengths in raising self-efficacy. The course provided the participants access to the required fundamental knowledge to help students for their science subjects. The participants gained self-efficacy and were empowered as they acquired knowledge and developed further understanding and control over their studies (Israel et al., 1994). More significant was active learning and interacting and engaging with peers. It was not only understanding discipline knowledge (Thalluri & Penman, 2019), but the development and honing of transferable skills that were essential for the successful engagement in health science disciplines. These skills included critical thinking, problem-solving, communication skills, scholarly writing, time management and several others (Davies et al., 2019). The course also focused on the inherent personal strengths of individuals in helping them approach the study of sciences to achieve better academic outcomes. These are referred to as strengths-based practices (Pulla, 2012), which promote coping, empowerment and resilience at university.

Furthermore, many aspects of the course depict the primary sources of self-efficacy (Mitchie et al., 2014). The real human organs/specimens with case scenarios, laboratory experiments/activities, and quizzes served as tasks to be mastered, providing opportunities to challenge the participants and gain a series of small successes in the process. These opportunities encouraged hands-on involvement and vicarious experiences, which could have resulted in greater interest in the content and activities. The participants felt positive, less anxious, and more committed in the study.

Guiding them to acquire usable knowledge and information, academic skills such as study, note-taking, research and writing skills, time management skills enabled them to act on their questions and needs, and become confident in managing and organising their study. These strategies could have contributed to capacity building and improvement of self-efficacy. The best way to learn a skill or improve performance is by participation and practice (Braungart et al., 2019). Part of the reason the course worked so well was that students were taught the basics, mentored to teach themselves, and encouraged to learn, connect, and apply new knowledge and skills to real-life scenarios. Also, there was a chance to meet core academic, technical staff and study advisors/counsellors, and mentors, and become familiar with campus facilities.

The participants had positive role models, who provided encouraging and motivating words to help boost confidence, belief and ability to achieve success, termed social persuasion. Maddux (2012) also referred to collective efficacy, where group members believed that their collective ability could meet shared goals. Lastly, emphasising good physical, mental and psychological health and well-being were similarly highlighted which again could have contributed to raising self-efficacy. Similarly, recent summer bridging programs to increase student self-efficacy have been reported (Ashley et al., 2017).

### ***Implications for Practice***

The theoretical insights gained in this study have significant pedagogical implications for commencing university students. Health science professionals and education policymakers should strive to design and implement preparatory courses that foster student coping and self-efficacy. Health science professionals could also learn from the findings as there appeared a limited understanding of what it means to care for and support science students. This research has revealed that part of that care and support involved the facilitation of preparatory science courses that encouraged self-efficacy, as well as the support systems from various university levels and disciplines, were imperative for the smooth transition experience to the university.

### ***Limitations of the Study***

Several limitations of this study were observed in conducting and reporting the analysis. A larger sample size would have been readily available if forms had been filled out thoroughly by the participants. It is also worth noting that due to the large effect size (Cohen's  $d = 0.8$ ), the results of our study need to be interpreted with caution as they represent a large effect relative to all the effects in educational research (Hattie, 2019). Self-efficacy is self-reported, thus, with the potential of bias. Self-efficacy is influenced by many factors, including parental, teacher and peer support, age, gender, self-esteem, and psychological well-being. No information on these factors was collected. Another potential limitation is the lack of a control group to compare with the treatment group. A control group will be considered in the next offering.

### **Conclusion**

Health science commencing students need to be supported in university; they are considered a priority group for educational intervention because they are at risk of delay or non-completion of study if they are not appropriately supported. The ScienceReady preparatory course was specifically designed for this purpose. The holistic and comprehensive design, content and delivery of the course were developed from the evidence of effective strategies to prepare students for science and university.

In contributing to the robust evaluation of the course, this article described a metropolitan campus's university preparatory course and the analysis of the survey data on its impact on students. Though constrained by small numbers, the ScienceReady course was successful in demonstrating the many positive impacts of the course on participants, specifically the significant increase of self-efficacy.



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