



Preparing Undergraduate Students for Summer Research Experiences and Graduate School Applications in a Pandemic Environment: Development and Implementation of Online Modules

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Abstract. Engaging students in research is a high impact practice that improves student retention and persistence in behavioral and biomedical sciences and engineering. The California State University Long Beach (CSULB) Building Infrastructure Leading to Diversity (BUILD) Program offers an intensive research training experience to undergraduate students from a wide range of health-related disciplines. The goal of this program is to provide students with research skills, psychosocial resources, and graduate school application guidance that will make them competitive for Ph.D. programs. With the COVID-19 pandemic forcing the campus closure of many universities, including CSULB, our student training had to transition from in-person training to online training. This paper discusses the development and implementation of a series of eight online modules for guiding students through the application process for summer research experiences and graduate schools. Overall, the BUILD trainees were positive about the online modules. Specifically, they indicated that the modules were useful, informative, easy to access/use, good use of their time, and a good supplemental activity to their learning community activities. Most trainees indicated that they preferred the modules to be implemented in a hybrid format, where the students can view the modules on their own first and then have an opportunity to engage in in-person/synchronous online discussions.

Keywords: Undergraduate training · Online modules · Professional development

1 Professional Development for Undergraduate Students

1.1 The CSULB BUILD Program and Background

Engaging students in research is a high impact practice that has been shown to improve student retention and persistence in STEM fields [1]. Funded by the National Institutes

of Health (NIH), the California State University Long Beach BUilding Infrastructure Leading to Diversity (CSULB BUILD) Program offers an intensive research training experience to undergraduate students from a wide range of disciplines from behavioral, health and natural sciences to engineering (for more information about the program, see [2]). CSULB BUILD offers two training programs: Scholars and Fellows. The Scholars Program provides 2 years of training for undergraduates who are starting their junior year, and Fellows is a 1-year program for graduating seniors. The training curriculum was designed to prepare students to apply to graduate schools and pursue a research career in health-related disciplines. In addition to the hands-on research experience that trainees gain from working with their faculty mentors, it covers professional development activities to enrich the students' training experience. This paper describes the creation, implementation, and evaluation of online modules that prepare students for their search and application to summer research experiences (SREs) and graduate schools.

The professional development modules on application for SREs and graduate schools were initially developed for in-person delivery as part of a learning community for CSULB BUILD trainees. The learning community format was intended to provide students, especially those from underrepresented backgrounds, with the knowledge and resources needed to apply to SREs and graduate schools in a culturally relevant and supportive context. Scholars and Fellows participate in the learning community with members of their own cohort.

Starting in March 2020, the COVID-19 pandemic forced the campus closure of many universities, including CSULB. The switch to remote or alternative modes of instruction meant that our student training activities had to transition from an in-person format to an online format. Fortunately, the CSULB BUILD Program leadership was already in the process of converting the modules relating to application for SREs and graduate schools to an online format as part of the broader plan for institutionalization of our grant-funded training curriculum. The content of the online modules, which consist of lecture and activities, was intended to be used as a starting point for in-person discussion during the BUILD learning community or with one-on-one meetings with the BUILD training directors and graduate assistants (called graduate mentors hereafter). An important advantage of the online format is that it allowed students the opportunity to re-visit the information at their own time and pace. This provided BUILD students with flexibility in viewing the modules since many students have very busy schedules. Moreover, research has shown that underrepresented students and students with family commitments have a greater preference for online course materials [3] because they are able to access the course materials outside of classes, especially during the night [4].

In the 2018–2019 academic year, the CSULB BUILD team worked with Academic Technology Services (ATS) on campus to create the first set of five online modules relating to graduate school preparation. These modules were designed to provide BUILD students with an overview of the graduate school application process and help them develop a SMART (Specific, Measurable, Achievable, Relatable, Time-based) [5] action plan that they can implement. In the 2019–2020 academic year, three additional online modules, *Individual Development Plan (IDP)*, *Summer Research Experience (SRE)*, and *How to Interview Successfully for Graduate School*, were developed.

Beginning spring 2021 all of these professional development modules were also made available to other undergraduate students at CSULB who are interested in learning about research opportunities and pursuing training at the graduate levels. Our goal is to expand their use on our campus and disseminate them to other institutions that serve diverse undergraduate students. Although the transition of these professional development modules to an online format was originally intended for sustainability and dissemination, the use of these modules proved to be highly instrumental during the shift to online learning due to COVID-19. This paper discusses the development and implementation of the eight online modules for guiding students through the application process for SREs and graduate schools before and during the pandemic. At the end of the paper, we provide lessons learned and recommendations for implementation at our campus and other universities.

1.2 Topics for the Online Modules in Support of Applications for SREs and Graduate Schools

A series of eight online modules (Table 1) were developed to support students with their applications for SREs and graduate schools. The modules vary in length and number of videos and quizzes.

Table 1. Module names, durations and contents.

Module name	Duration	# of Videos	# of Quizzes
Individual Development Plan (IDP)	19 m 19 s	14	1
Graduate School Application Process	36 m 53 s	9	6
Curriculum Vitae and Statement of Purpose (CV & SOP)	41 m 35 s	20	1
Letter of Recommendation (LOR)	24 m 4 s	7	1
Summer Research Experience (SRE)	21 m 32 s	10	1
GRE Preparation and Expectations	59 m 5 s	18	2
How to Interview Successfully for Graduate School	24 m 28 s	13	1
Seeking Financial Support for Graduate Schools	20 m 49 s	6	1

The online module series begins with a module on the *IDP* that was designed to help students set goals to guide them through the undergraduate research training process. Originally created to support the professional development of postdoctoral fellows, IDP is now regarded as an effective tool for undergraduate students' preparation for graduate education and research careers [6]. Our IDP module explains what an IDP is; the difference between short-term, intermediate, and long-term goals; the importance of setting goals and re-visiting/up-dating them; how to identify and assess skills; tips for bridging gaps in desired skills; and how to get input from mentors, peers, and family members. The module encourages students to pause at various timepoints to access the

templates related to goal setting and skill assessment. At the end of the module, students are expected to produce their own IDPs.

Because our training program is geared towards preparing students for a doctoral program that leads to a research career, the module on the *Graduate School Application Process* provides students with a step-by-step overview of the graduate school application process, describes the different types of masters and doctoral degrees available in health-related disciplines, and discusses important factors to consider when researching and selecting potential graduate programs. The module also includes the importance of having a “Plan B,” in case students do not get into a Ph.D. program the first time that they apply.

The next module was designed to provide students with information on preparing a *Curriculum Vitae (CV) and Statement of Purpose (SOP)*, essential elements of both SRE and graduate school applications. The *CV & SOP* module was divided into two sub-modules. The CV sub-module explains how to present biographical information, education, research activities, teaching activities, additional professional experiences, grants, honors and awards, service and publications and provides specific examples. The SOP sub-module explains the purpose and structure of the SOP and provides strategies to compose and revise one with specific examples and hands-on writing activities for each step of the writing process.

The *Letters of Recommendation (LOR)* module was designed to help students learn about the materials and processes they should use for obtaining LOR from their research mentors and course instructors to accompany their applications. This module also includes: what programs look for in LOR, who is qualified to write letters, the request timeline, as well as examples for an application portfolio that they can provide their letter writers. Trainees create an application portfolio with an IDP, CV, and SOP for use when requesting LOR.

The portfolio also provides the foundation to help students find external research opportunities such as SRE. The *SRE* module provides students with guidance and tips on how to find and apply to rigorous and competitive SRE programs at research-intensive universities, government laboratories or industry settings. The *SRE* module explains what an SRE is, the benefits of undergraduate research, where to look for SRE programs, how to apply, the SRE application timeline, and how to discuss SRE programs with family members who may be hesitant with their college student traveling and staying away from home for an extended period of time. The module also includes additional tips and video testimonials from past student trainees who participated in an SRE.

The remaining three modules are specifically targeted toward graduate school applications: preparing students for the GRE, interviewing, and financing graduate school. The *GRE* module provides an overview of the exam and its process and explains how the GRE scores are typically used in graduate program admissions. Specific topics in this module include: how to create an ETS account, what to expect on the day of testing, the structure of the computer delivered/online test, a discussion of when to take the GRE, and a description of each section of the test. In addition, students are introduced to fee reduction programs as well as given guidance for test preparation and how to select and send their scores to a graduate program. The module also addresses some of the factors that may influence underrepresented minority students’ preparation for the exam (e.g.

cost of preparation courses or materials) and performance on the exam (e.g. test anxiety) and what students can do to mitigate their impact.

The *How to Interview Successfully for Graduate School* module discusses what students should expect and plan for when interviewing for graduate school. Specific topics include: the purpose of the interview (i.e., why the interview is important), typical components of an interview, how to prepare for an interview, and what to expect in terms of logistics and financial support for the interview day and/or travel to the programs. This module also includes video testimonials from past student trainees who shared tips and recommendations based on their personal experiences.

Finally, the *Seeking Financial Support* module provides an overview of the timeline for financial aid and other types of funding mechanisms. It also describes the differences in funding options available to students for graduate school such as fellowships, grants, and teaching and research appointments and explains the advantages and disadvantages of each type of funding option. Finally, it explains how students should evaluate different kinds of funding packages that graduate programs typically offer.

As indicated in Table 1, the modules contain quizzes that assess students' understanding of the content and serve as an indication of completion to progress to the next module in the series. Although the modules have been described above in a specific order, each was designed to be a stand-alone module and can be assigned to students in any order. In the CSULB BUILD Fellows Program and Scholars Program, modules are selected to cover appropriate topics based on the curriculum of the specific training program in which a trainee participates. For example, the activities for Fellows who are graduating seniors primarily focus on preparing them for graduate school application, whereas the activities for Scholars focus on application to SREs in their first year of the program and graduate school application during their second year.

2 Method

2.1 Subject Matter Experts

The subject matter experts (SMEs) that created the content of the online modules were recruited from the training directors of the CSULB BUILD Student Training Program and other staff members at the university's Graduate Studies Resource Center. Training directors include the Principal Investigators and Associate Director of the BUILD Program as well as faculty members from four colleges (Engineering, Health and Human Services, Liberal Arts, and Natural Sciences and Mathematics) participating in the BUILD Program. SMEs also recruited students who completed SREs and graduate interviews to share their experience and advice. Training directors developed and refined the content of each of the learning community modules that were delivered in-person. All SMEs have extensive experience in the topic areas that they covered, are active mentors to undergraduate students, and have the knowledge, skills, and abilities to generate content appropriate for the online modules.

2.2 Module Creation and Editing

A BUILD module coordinator worked with the SMEs and instructional designers from ATS to create the modules. The SMEs and instructional designers were paired to work on specific modules together. The role of the coordinator was to provide continuity of the module development across the different SMEs and instructional designers. The following activities outline the general process used for creating and editing the modules. The specific activities that the coordinator, SMEs, and instructional designers engaged in varied slightly from one module to another module.

1. Development of each module began with a “kick-off” meeting with the coordinator, the SME(s), and instructional designers assigned to the module. The kick-off meeting was intended to allow the various individuals working on the project to meet each other and to set up expectations about what would be involved in the module creation.
2. The SMEs worked with their assigned instructional designers to create an initial conceptual map that typically went through several iterations.
3. The SMEs provided content for the module to the instructional designers. The content included PowerPoint™ lecture slides, web resources, documents, worksheets and a script (i.e., narration for the videos). When the SMEs and recruited students (for testimonials) completed the script writing and/or presentation slides, the designated instructional designers used them to create storyboards to capture the instructional designers’ vision for the module design. Next, they met with the SMEs and students to map out the parts that would be video recorded or audio recorded with graphic slides and videos created by the instructional designers. All slides were converted to either Prezi or other graphic presentation format.
4. The instructional designers selected the initial graphic content, scheduled and edited the audio and video recordings, and formatted other materials (e.g., quizzes, hand-outs, web pages). For graphic presentations, photo images or video files were selected to enhance the delivery of content along with text summaries. All images, videos, and text displays were reviewed and approved by the SMEs.
5. All modules included a combination of video-recorded introductions and voice-over Prezi or graphic presentations. For each module, the introduction video featured one of the SMEs who prepared the module so that the students would know what the “presenters” look like and make the module relatable. At least one more segment was video recorded with the SMEs to break the monotony of the voice-recorded graphic presentations.
6. The instructional designers delivered drafts of the modules and their supplemental material for the SMEs and the coordinator to review and provide feedback. This step was an iterative process. Some modules (e.g., *How to Interview Successfully for Graduate School*) contained videos with student testimonials, and the student presenters approved the use of their videos.

7. The instructional designers uploaded the “full” versions of the modules into the learning management system for pilot testing.
8. Each module was reviewed for clarity and appropriateness by the 2019–2020 cohorts of BUILD trainees who used the beta versions as part of their learning community activities.
9. The instructional designers uploaded the “final” versions of the modules, with closed captioning added, into the learning management system.

2.3 Implementation in Course Management System

Once all the modules were developed, the instructional designers uploaded them into BeachBoard, the Desire-2-Learn (D2L)-based learning management system used at CSULB. The module coordinator and SMEs checked the components in the modules and made revision requests to ATS, if necessary. Figure 1 illustrates the homepage for the course, and Fig. 2 is a screen shot of the content for one of the modules.

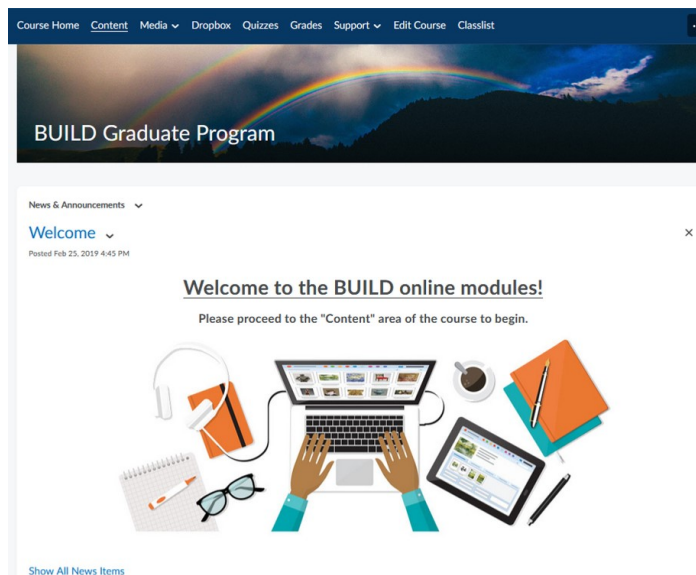


Fig. 1. Screenshot of the BUILD online module homepage implemented in CSULB’s learning management system.

BUILD training directors are able to export the entire content of the module from the host course or any of its components into their own course for use in a particular learning community.

The screenshot displays the 'Graduate School Application Process' module. On the left is a sidebar with a search bar and a table of contents listing various topics with their respective counts. The main content area shows the module title, options to add dates, descriptions, and activities, and a list of activities including video introductions and a quiz.

Topic	Count
Graduate School Application Process	20
Introduction to Graduate Application Process	5
PH.D. Explained	2
Important Factors to Consider	4
Selecting Programs to Apply To	3
Plan B - What To Do If You Don't Get In	4
Conclusion	1
Curriculum Vitae and Statement of Purpose	21
Letter of Recommendation	9

Activity	Duration	Type	Status
Start Here Guide to Videos	-	Web Page	✓
Introduction to Graduate Application Process	-	-	-
Introduction - Part 1: Graduate School-- What and Why	3 mins 2 sec	Web Page	✓
Introduction - Part 2: Aspects of a Master's Degree	3 min 42 sec	Web Page	✓
Introduction - Part 3: Overview of Graduate School Application Process-- Elements and Timeline	1 min 34 sec	Web Page	✓
Self Assessment Explained	37 sec	Web Page	✓
Quiz - Introduction to Graduate School Application Process	-	Quiz	✓

Fig. 2. Screen shot of the *Graduate School Application Process* module implemented in CSULB's learning management system.

3 Implementation

Both the Fellows Program and Scholars Program begin with an eight-week intensive summer training session called Summer Undergraduate Research Gateway to Excellence (SURGE). SURGE consists of a weekly commitment of 40 h, including a 3-h-long twice-a-week summer learning community run by their respective training directors. During the academic year, the commitment is reduced to 15–20 h weekly, with a 1-h-long weekly learning community. The online professional development modules were incorporated into the learning community curriculum.

3.1 2019 Pilot Testing of Beta Versions

The pilot testing was conducted in summer and fall of 2019 with the beta version of four of the first module set: *Graduate School Application Process*, *LOR*, *CV & SOP*, and *Seeking Financial Support*. Fellows ($n = 15$) who were in their final year at CSULB viewed all four modules. They began with two modules that were completed in summer 2019: *Graduate School Application Process* and *LOR*. Trainees were instructed to first watch the video recordings on their own time. The viewing of the modules was supplemented by in-person lectures and a homework assignment. For homework, the trainees were instructed to conduct research on potential graduate programs that they might be interested in applying to and develop their "Preliminary List of Graduate Programs" using the criteria explained in the *Graduate School Application Process* module. All

Fellows viewed the entire *Graduate School Application Process* module. All but one Fellow viewed the entire *LOR* module, and the remaining trainee viewed more than 70% of the videos.

Following the completion of the initial two modules, the Fellows cohort watched the next two modules, *CV & SOP* and *Seeking Financial Support*, in fall 2019. Because students had already created their CV during the summer program, the focus in the fall semester was on the SOP sub-module. The group had three in-class breakout activities during their learning community to develop and refine their SOP after viewing the module. Lastly, the *Seeking Financial Support* module was not paired with a formal discussion about the topic immediately following the viewing because their contents were self-explanatory. Students were required to complete the module quizzes for both modules. The quizzes were used to track students' completion of the modules and were part of the graded activities for the learning community. Two-thirds of the Fellows watched all of the videos for the *SOP* sub-module, 20% did not view any of the videos, and 13% viewed between 30–60% of the videos. For the *Seeking Financial Support* module, 80% of the Fellows watched all of the videos, 13% did not view any of the videos, and the remaining trainee viewed more than 80% of the videos.

The first year Scholars trainees (hereafter referred to as Scholars 1; $n = 16$) did not pilot test the *Graduate School Application Process*, *LOR* and *Seeking Financial Support* modules as those contents were meant for trainees applying to graduate programs. Instead, the Scholars 1 cohort focused on the *CV & SOP* module, which was delivered in fall 2019 in a fully hybrid format consisting of asynchronous online and in-person instructions. Specifically, in preparation for their SRE applications, the Scholars 1 trainees were assigned to view the entire *CV & SOP* module on their own, created their first draft CV and SOP, and refined each two more times with the advice of their training director. The Scholars 1 cohort had one in-class and one outside-of-class feedback session on CV and two in-class breakout activities and two outside-of-class feedback sessions to refine their SOP. Even though the *CV & SOP* module was assigned, students were not required to complete the quizzes and their viewing was not part of their grade. The Scholars 1 trainees were also encouraged to view the remaining modules on their own as they became available, but these modules were not graded for their learning community. Implications of this “volunteer” form of delivery will be discussed later along with the evaluation survey results for this cohort.

In terms of usage, 43% of the Scholars 1 cohort viewed all CV videos and 56% of them viewed at least half of the CV videos. Only 19% of the Scholars 1 cohort viewed all SOP videos and 43% viewed at least half of the SOP videos. The lower viewership of the CV & SOP videos for this cohort may be the result of these modules not being part of the graded learning community activities. Also, only one Scholars 1 trainee viewed all of the graduate application process videos and 2 additional students viewed one of those videos (i.e., only 19% of the students viewed any videos for this module).

Despite the lower usage rate for the Scholars 1 cohort, feedback from a BUILD program evaluation focus group and informal conversations with the Scholars and Fellows, their near-peer graduate mentors, and the training directors who used the modules in their learning community revealed that the modules were promising. The trainees generally found the module content helpful and preferred to keep each sub-module video in

a shorter length. Some problems with viewing the modules and the quizzes on Beach-Board were reported and resolved for the subsequent versions. The training director of the Scholars 1 Program shared that the modules ran smoothly and the trainees produced an excellent second draft CV. For many Scholars 1, the second draft was good enough to be their final CV for their SRE application.

3.2 2020 Implementation of the Full Set of Online Modules During Remote Learning Instruction Period

Due to the pandemic, CSULB pivoted to fully remote instruction beginning mid-March of 2020. Accordingly, the CSULB BUILD Program had to finish its in-person training activities for the academic year of 2019–2020 in a virtual format and modify the training curriculum to make it fully virtual for 2020–2021 academic year. The online professional development modules provided much-needed flexibility in delivery, while allowing students to have remote access to critical information. By June 2020, the remaining modules, *IDP*, *SRE*, and *How to Interview Successfully for Graduate School*, were completed. Therefore, we were able to implement the full set of online modules for the virtual Fellows Program and Scholars Program beginning summer 2020.

A new cohort of Fellows trainees ($n = 15$) began the virtual SURGE training in June 2020. Six of the online modules were assigned as required asynchronous assignments outside of the twice-a-week synchronous learning community meetings. Those modules were: *Graduate School Application Process*, *GRE*, *CV & SOP*, *LOR*, *IDP*, and *Seeking Financial Support*. Fellows watched the modules in the order listed above over the period of eight weeks of SURGE. Following students' asynchronous viewing of each module, the next synchronous session provided "in class" time for discussion, sharing of examples and templates, drafting of documents and statements, and feedback from the training team on student drafts. The SME who created the *Seeking Financial Support* provided a Q&A session with the trainees following the module. The only module that did not include a focused discussion during SURGE was the *LOR* module. This topic was part of a synchronous discussion later in the fall term, when students began requesting letters from faculty.

In fall 2020, Fellows viewed the *How to Interview Successfully for Graduate School* module during the final weeks of the semester. During the last synchronous learning community of the fall semester in December 2020, training directors provided more details and tips for interviewing. By the time students viewed this module, they had finalized a list of prospective graduate schools and had already begun submitting applications. Since invitations to interview would soon follow, the timing of this module and the subsequent discussion were appropriate.

The new cohort of Scholars 1 ($n = 16$) also began with a virtual SURGE training in June 2020. They first viewed the *IDP* module asynchronously, followed by synchronous discussion of their IDP with other Scholars during a breakout session. In the fall, three additional online modules were assigned: *CV & SOP*, *SRE*, and *LOR*. The *CV & SOP* and *SRE* modules were covered in a hybrid format that consists of asynchronous viewing of the video modules followed by synchronous virtual class activities. For example, after viewing the module videos on their own, Scholars 1 trainees created the first draft CV and SOP, and refined each two more times in preparation for their application for

the SRE next summer. As in the Fellows cohort, the group had one in-class and one outside of class feedback session on CV and four in-class breakout activities and two outside of class feedback to refine their SOP. Each draft of CV and SOP was graded by the graduate mentors. Training directors and students' faculty research mentors also provided feedback on the last two drafts of CV and SOP. Unlike the pilot testing of the beta versions in 2019–2020, the 2020–2021 Scholars 1 cohort was required to take a quiz for each module as graded activities for the BUILD learning community.

As in the pilot testing of the beta version, we continued to gather feedback in class from the BUILD trainees. Many trainees commented that the people in the photos and videos were often mostly or all White and/or represented non-academic, business, corporate or commercial settings as they were from standard stockpile images accessible by ATS. In order to address this group feedback, a group of BUILD trainees volunteered in fall 2020 to give more detailed review and feedback, with a particular focus on the photo and video images to make sure that the images of people are representative of our diverse student body and relatable for our students. In response, the ATS purchased or created original images of individuals that are more diverse and reflective of academic settings and contexts. Any images replaced by the instructional designer were then reviewed and approved by the SMEs of the corresponding module or by the module coordinator.

4 Evaluation of 2020 Virtual Module Implementations

4.1 Data Source

Evaluation of the virtual implementation of the online modules was based on (a) instructor feedback, (b) student usage data from the course management system and (c) student self-report data from an online evaluation survey. The online evaluation survey was administered in January 2021 to trainees currently in the program to assess trainees' general experiences with the online modules on their informativeness, usefulness, accessibility, length, etc. Trainees consist of the 2019–2020 Scholars 1 cohort (referred to as 2019 Scholars 1, Pilot), 2020–2021 Fellows cohort (2020 Fellows), and 2020–2021 Scholars 1 cohort (2020 Scholars 1). Note that the 2019 Scholars 1, currently in the second year of the program, are referred to as the Pilot group that serves as a comparison group for the fully virtual implementation of the modules. Unlike the 2020 cohorts who have been remotely trained due to the pandemic, the pilot group viewed the beta version of the online modules asynchronously and discussed the materials synchronously in person. The 2019–2020 Fellows cohort who also viewed the beta version did not participate in the online survey as they already completed the BUILD training in May 2020 and graduated from CSULB.

4.2 Instructor Feedback

Training directors reported that the use of the online modules during SURGE 2020 was beneficial to students in three ways. First, it helped to reduce the number of hours that students had to participate in synchronous virtual lectures, and it allowed training directors to allocate more time for interactive activities. Second, it provided students with

ongoing access to important foundational information outside of formal meeting times. Third, students gained more time to spend on guided practice and to receive feedback during synchronous meetings with their training directors and graduate mentors.

In addition, the modules provided sufficient foundational knowledge so that trainees could draft meaningful versions of their IDP, CV, and SOP before the SRE and graduate school application season began. After receiving feedback from training directors and graduate mentors, trainees had drafts to review with their research faculty mentors when they met to discuss their applications.

4.3 Student Usage and Feedback

Only a subset of the three cohorts of trainees enrolled in the BUILD learning community during spring 2021 completed the survey: 2019 Scholars 1, Pilot (n = 11), 2020 Scholars 1 (n = 13), and 2020 Fellows (n = 15).

Usage Data. Usage data obtained from the course management system were analyzed by examining the percentage of trainees that accessed the modules (i.e., viewed at least one video), the percentage of trainees that viewed the entire module (i.e., viewed all videos), and average percentage of videos viewed by trainees.

During SURGE, the 2020 Fellows cohort was assigned 6 modules consisting of 97 videos/documents. The Fellows viewed on average 96% of all module materials, with 73% of Fellows trainees viewing all of the content in the modules. The 2020 Scholars 1 cohort was assigned the *IDP* module consisting of 20 video/documents. The trainees viewed on average 92% of all *IDP* module materials, with 69% of Scholars trainees viewing all of the content in the modules.

In fall 2020, additional modules were assigned as part of the learning communities for all three BUILD cohorts. The 2020 Fellows were assigned one module consisting of 14 video/documents. They viewed on average 80% of all module materials, with 60% of trainees viewing all of the content in that module. The 2020 Scholars 1 were assigned three modules consisting of 75 video/documents. Trainees viewed on average 67% of all module materials. No trainee viewed all of the content in the modules, but 2 trainees (12.5%) viewed more than 90% of the materials and 5 trainees (31%) viewed more than 70% of the materials. The 2019 Scholars 1 (Pilot), now in their senior year, were not assigned specific modules. Instead they were recommended to review the modules in preparation of their graduate school applications and the quizzes were not enforced. Only 50% of these trainees accessed any of the modules during their 2nd year.

Trainees were also asked to report on the online survey which of the eight modules that they viewed during SURGE and during the academic year learning communities. The percentage of trainees in each cohort that viewed a particular module is illustrated in Fig. 3a–c. These self-report data matched the usage data obtained from the course management system described above.

Subjective Feedback. On the online survey, trainees were asked a series of questions with the stem, “Based on your experience with the online module(s) you have viewed, please indicate your level of agreement for each of the following statements about the module(s)” on a 5-point Likert-like scale (1 = strongly disagree, 2 = somewhat disagree, 3 = neither agree nor disagree, 4 = somewhat agree; 5 = strongly agree). One sample

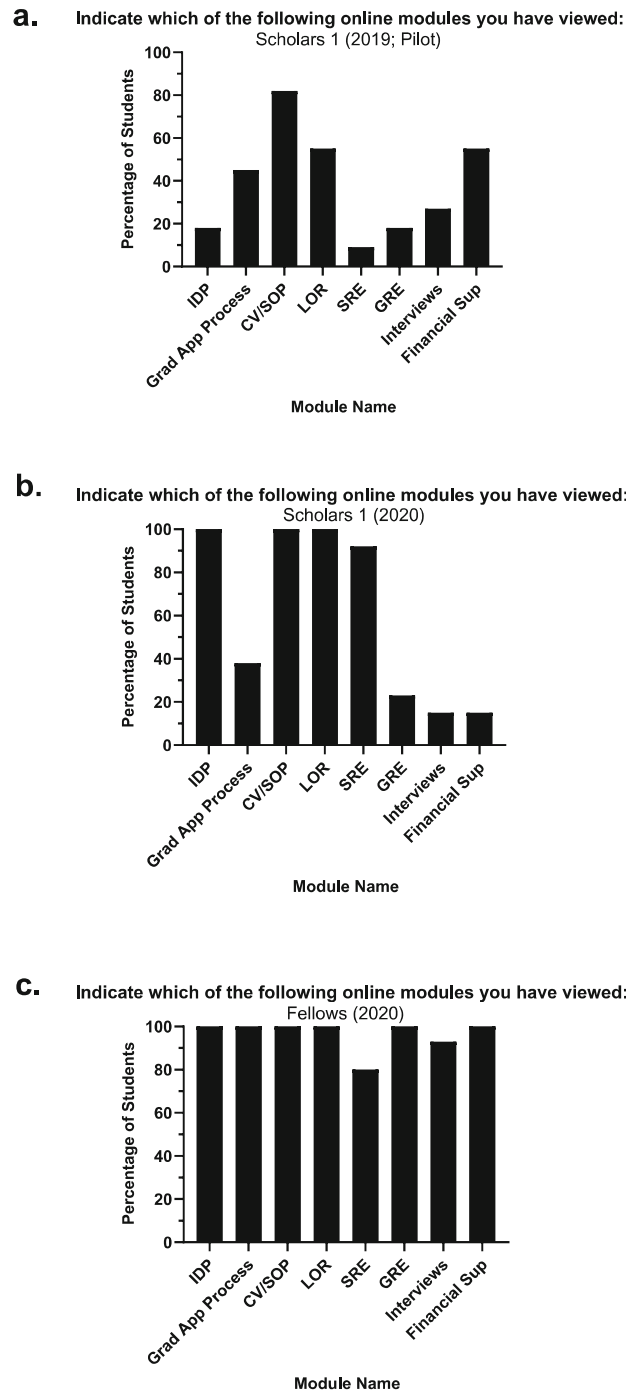


Fig. 3. Percentage of BUILD trainees who viewed each of the specific online module topics: a) 2019 Scholars 1 (Pilot); b) 2020 Scholars 1; c) 2020 Fellows

t-tests were performed on the ratings for each question, collapsed across cohorts, against a test value of 4 (somewhat agree) to gauge the strength of trainees’ overall endorsement for each item. Table 2 shows the mean ratings and the results of t-tests. One-way analyses of variances (ANOVAs) were also run for each question with the BUILD cohort (2019 Scholars 1, Pilot; 2020 Scholars 1; or 2020 Fellows) as a factor to determine whether

there is a significant difference between the pilot implementation of the beta versions of the online modules and the fully virtual implementation of the revised modules. The F -ratio and p -value for each analysis are also provided in Table 2. The alpha-level was set as 0.05 for statistical significance. Figure 4 (a–h) illustrates the mean ratings by cohort for questions showing a significant effect of cohort.

Table 2. Ratings on a 5-point Likert-like scale (1 = strongly disagree to 5 = strongly agree) to each survey question. Statistics for the one sample t-tests and ANOVAs are listed in the last two columns. Significant effects are highlighted in bold.

Question	Mean	St. Dev	Test value = 4.0	Effect of Cohort
The module(s) was/were informative (i.e., the module(s) covered all the information that I would need to know about this topic and/or I learned a lot about the topic)	4.65	0.58	t(39) = 7.09, p < 0.001	F(2,36) = 6.13, p = 0.005
The module(s) was/were useful (i.e., the information is relevant and I have/will be able to use the information. For example, I learned to prepare applications for summer research experiences/graduate schools)	4.53	0.68	t(39) = 4.89, p < 0.001	F(2,36) = 5.31, p = 0.010
The module(s) was/were easy to use (e.g., easy to navigate through)	4.58	0.71	t(39) = 5.11, p < 0.001	F(2,36) = 2.57, p = 0.091
The module(s) was/were easy to access (e.g., accessible from computer or mobile device)	4.60	0.81	t(39) = 4.68, p < 0.001	F(2,36) = 0.94, p = 0.401
The module(s) was/were appropriate in length (i.e., not too long or too short)	4.38	1.03	t(39) = 2.30, p = 0.027	F(2,36) = 1.36, p = 0.270
The module(s) was/were a good supplement to the learning community activities	4.55	0.85	t(39) = 4.11, p < 0.001	F(2,36) = 2.30, p = 0.114

(continued)

Table 2. (continued)

Question	Mean	St. Dev	Test value = 4.0	Effect of Cohort
The module(s) was/were appropriate as a stand-alone learning activity (i.e., I can fully use the information presented in the module(s) without additional guidance or activities)	4.23	0.87	$t(38) = 1.65, p = 0.107$	$F(2,35) = 1.66, p = 0.205$
The module(s) was/were a good use of my time (i.e., it saved my time by providing information that would have taken more time for me to find on my own)	4.60	0.59	$t(39) = 6.43, p < 0.001$	$F(2,36) = 12.08, p < 0.001$
The graphics/videos in the module(s) were appropriate for the topics being covered	4.67	0.58	$t(38) = 7.21, p < 0.001$	$F(2,35) = 6.81, p = 0.003$
The graphics/videos in the module(s) were “professional” looking	4.62	0.63	$t(38) = 6.07, p < 0.001$	$F(2,35) = 4.07, p = 0.026$
The graphics/videos in the module(s) were relatable to me	4.33	0.81	$t(38) = 2.58, p = 0.014$	$F(2,35) = 3.52, p = 0.040$
The graphics/videos in the module(s) were representative of students at CSULB	4.33	0.87	$t(38) = 2.40, p < 0.022$	$F(2,35) = 2.83, p = 0.073$
The quiz or quizzes in the module(s) fairly assessed my familiarity, knowledge and understanding of the content of the module(s)	4.30	0.82	$t(39) = 2.31, p = 0.027$	$F(2,36) = 6.78, p = 0.003$
I would recommend the module(s) to a friend who wants to learn more about the topic(s) covered by the module(s)	4.55	0.71	$t(39) = 4.87, p < 0.001$	$F(2,36) = 12.36, p < 0.001$

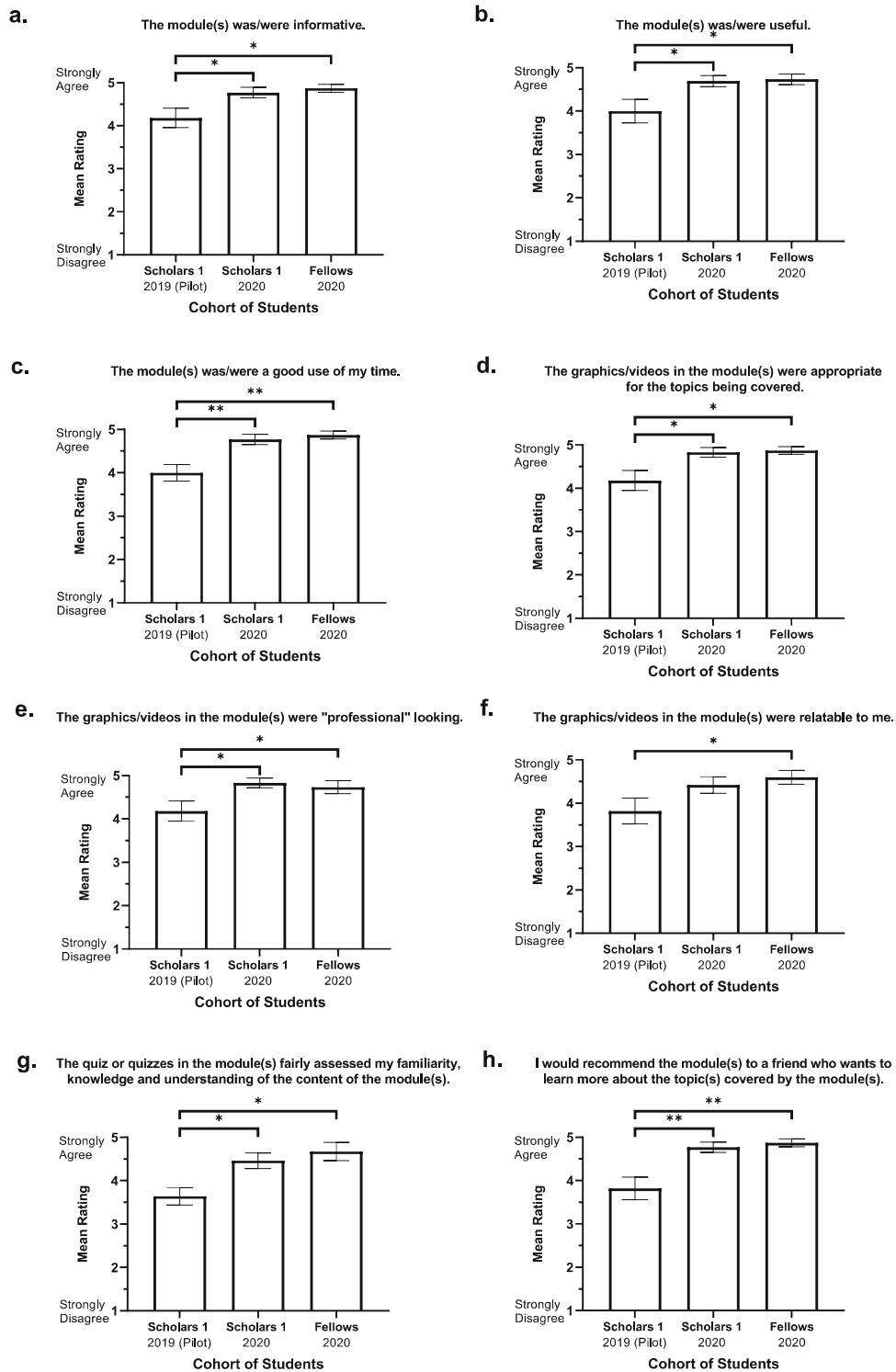


Fig. 4. Mean rating of the module(s) by cohort for a) informativeness, b) usefulness, c) good use of time, d) appropriate graphics/videos, e) professional looking, f) being relatable, g) fairness of quizzes, and h) recommend to a friend. Post-hoc Bonferroni pairwise analyses were conducted and illustrated as * for $p < 0.05$ and ** for $p \leq 0.001$.

The BUILD trainees were also asked to indicate their preference for use of the modules as a learning activity. Specifically, they were asked to indicate whether they preferred the modules to be used as an asynchronous online only activity, hybrid (i.e., students watch the videos asynchronously and the contents are discussed during in-person/synchronous sessions), or fully in-person/synchronous activity. As illustrated in Fig. 5, most of the 2020 Fellows and 2019 Scholars 1, Pilot preferred to have the modules in a hybrid format. The 2020 Scholars 1 equally preferred the hybrid format and the online modules only format.

**Based on my experience with the module(s),
I prefer to have the content covered in the following format:**

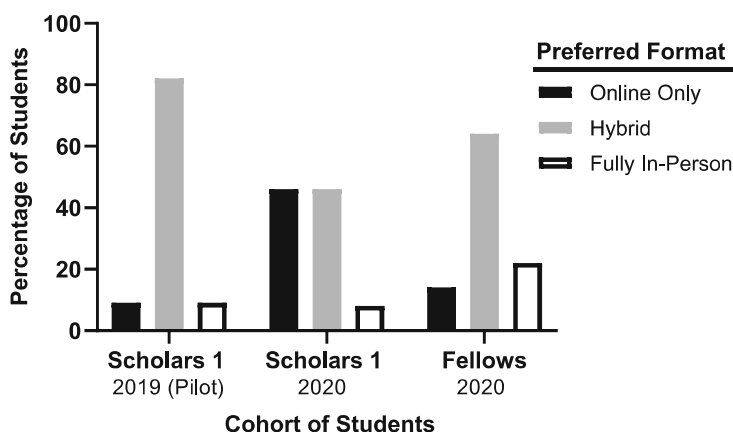


Fig. 5. Percentage of BUILD trainees per cohort who preferred the modules being offered in the different formats.

Open-Ended Responses. When asked, “Please indicate what you liked about the module(s) as a supplemental learning activity”, 34 of the trainees provided written comments. Several themes emerged, and we provide sample quotes to illustrate each of these themes below.

Almost two-thirds of the comments (65%; $n = 22$) indicated that the students liked the modules because they were easy to access, useful, and informative:

1. *I liked how well they were put together and informative. Also loved seeing my directors and faculty.*
2. *Provided a comprehensive introduction to the topics.*
3. *... the informational videos were relatively concise and broken up to make it easier to digest information.*
4. *They provide essential information step-by-step. I have utilized many of the advice when applying for summer research programs or drafting my SOP and CV.*

Over one-third of the comments (35%; $n = 12$) indicated that the students liked the ability to view the modules at their own pace and/or revisit the modules:

1. *I highly appreciate that we can go back to modules for future reference.*
2. *I liked being able to complete them at my own pace. It allowed for me to be familiar with the material and prepare questions for the follow-up meetings rather than using the time to introduce the topic.*
3. *It is helpful that you can pause, slow down and go back in the video modules to re-grasp the information provided. Also, I always use the CC because I tend to miss things when I hear them but when I can read it as well, it is beneficial for my understanding.*

When asked, “Please indicate what you did not like about the module(s) as a supplemental learning activity. Can you think about a way (or ways) to improve BUILD’s use of the module(s)?”, 29 out of 37 trainees provided written comments. The following quotes are organized by themes.

Almost one-quarter of the comments (24%; $n = 7$) indicated that the students did not dislike anything or did not have suggestions for improvement:

1. *The videos/modules were good as is!*
2. *... these modules provided very important information and were great in every way. Although I would have liked everything in person, the internet is a great tool because I was able to access the information on my own time and multiple times if I needed to.*

Almost one-quarter of the comments (24%; $n = 7$) indicated that the students did not like the number of short videos or wanted to know how long it would take to view the entire module:

1. *I did not like having to change the page in between videos, and not knowing how long the whole module was going to take before I started working on it.*
2. *I did not like how the videos were split up into multiple short sections.*
3. *The way the videos were broken up. I think some could have been combined.*

Some students (17%; $n = 5$) indicated that the modules were too basic or too general, and did not have enough specific examples:

1. *I believe this is a general view of the processes that take place. If there was a bit more of more unique situations being shown, that would be great.*
2. *Some modules should include more extensive information.*
3. *The information that was covered was mostly introductory/basic*

Some students (17%; $n = 5$) indicated that the modules needed to be part of discussions of the learning communities so that students can ask questions:

1. *I liked the modules as a supplemental learning activity, however, I think there may be room for discussion in an LC (learning community) session.*
2. *Incorporating the modules as assignments or as part of the LC presentations could motivate more participation in using the modules.*

3. *The only issue with the modules is that if I have questions, I am unable to have those questions answered right away...*

A few students (10%; n = 3) indicated that they would have liked a summary added to the modules:

1. *I would suggest providing a summary sheet of the info covered, like in bullet point format. That way students can reread the summary in the future without clicking through all the videos.*
2. *... the graphics could/should be combined to create flyers to summarize key points.*
3. *... The quizzes for some modules could do with more questions; the quiz was helpful in summarizing/reminding me of what I learned, so only having 5 questions is not enough to remind me of most of the covered information.*

Two students (7%; n = 2) provided other comments:

1. *I do think some of it was repetitive. I think we go over a lot of it in LC so it makes the modules a little redundant¹*
2. *Just to make sure to have CC on all the videos uploaded for accessibility*

5 Discussion

The online modules on the topics relating to applying for graduate schools and SREs were viewed by students who participated in the BUILD Program between summer 2019 and fall 2020. More trainees viewed the modules when they were not only assigned to them, but when there was also a grade assigned to the activity. Overall, the BUILD trainees were positive about the modules that they viewed. Specifically, they agreed that the modules were useful, informative, easy to access/use, a good use of their time and a good supplemental activity to their learning community activities. The trainees also found the video/graphics to be appropriate, professional looking, and relatable. The only question with which trainees did not agree was, “The module(s) was/were appropriate as a stand-alone learning activity...”. This finding is consistent with the preference for a hybrid approach to using the modules from two of the cohorts.

Our results are also consistent with a meta-analysis of studies comparing online, hybrid, and traditional in-person courses performed by the US ED [7], that found hybrid courses (instruction that combines online and in-person components) to be more effective than purely in-person and purely online instruction. Moreover, the use of online modules in a hybrid format provides students with more flexibility in their schedules. Thus, even when in-person classes resume, we will explore continuing to use the online modules in a hybrid format. They can continue to be assigned prior to an in-class discussion about the topic and/or used at appropriate times in the semester as a way to review the information prior to taking a specific step in the SRE or graduate school application.

¹ This comment was from a trainee in the 2019 Scholars 1, Pilot cohort. This cohort received in-person instruction on the topics that were covered in some of the modules.

Finally, the online modules themselves can be further improved by expanding the quizzes and providing a summary sheet for each module's highlights that students can view in one place and could also be downloaded and/or printed.

5.1 Lessons Learned

When using the modules in the future, trainee feedback shows that instructors should explain that some modules are intended to provide an introduction to the topic. In addition, students should take notes and record their questions to be addressed during the next in-person or synchronous session to maximize the learning. Students who are unfamiliar with hybrid learning may simply forget to use some of the strategies that they normally use during in-person classes. Instructors should therefore provide tips for using educational videos.

The timing of most module assignments aligned well with the discussions that were planned for the synchronous sessions. However, it may be more beneficial for graduating trainees to view the LOR module at the beginning of the fall semester, rather than during the summer term. There is more discussion about requesting LOR in fall when faculty return to campus and are available to receive student requests.

Another finding from our use of online modules as a part of student training is that enforcing the quizzes helps to ensure that trainees complete the modules in their entirety. The results indicate that students who were required to view the modules and complete the quizzes did so at a much higher rate than trainees who were encouraged but not required to do so. More importantly, these trainees perceived the modules more favorably in all regards compared to the 2019 Scholars 1, Pilot cohort who did not view the videos as part of grading requirement (refer to Fig. 4 a through h). Feedback to expand quizzes provided by a trainee also revealed that the assessments help trainees reinforce the content they just learned from viewing the videos.

Lastly, simply having access to online modules did not lead to sufficient utilization. The 2019 Scholars 1, Pilot group's lower usage as well as lower perceptions of helpfulness of the modules suggest that if implemented, modules need to be a required activity with grading consequences. This can ensure that students view sufficient content to benefit from the modules.

5.2 Recommendations for Dissemination and Adoption

The successful development and implementation of online modules depend on a coordinated team effort. Involving faculty, staff, and resources that are available through the campus contributes to successful collaboration. The results also show that students appreciate seeing and hearing familiar faces and voices (i.e., diverse representation) when viewing the modules.

Because development began ahead of the pandemic, the online modules were completed and ready for student use when there was a sudden need to move to remote learning. Creating tools such as the online modules can provide greater flexibility both in times of crisis and when serving students with diverse needs. There is now an opportunity for universities to develop and introduce online modules so that instructors and students can use them in ways that enhance in-person meetings.

One strategy that may improve the experience of using the online modules as a fully virtual learning tool is the use of an online discussion board. This strategy was not employed in this study. However, our trainees expressed their need to pose questions or ask for clarification while viewing. Instructors can determine whether the discussion boards can be used for students to post questions, relevant examples, and/or additional information and resources related to the topic.

While many campuses now use a learning management system, it is still important to stress that the interface should be user-friendly for both the instructor who manages the content and the students who will access the content. Accessibility concerns also include student access to technology, high-speed internet, and a physical space that is conducive to remote learning. Just as important is ensuring that students who are hearing and/or visually impaired can receive full benefit from module contents. Finally, when the course ends, instructors will need to ensure that students continue to have access to the modules so that they can refer to them in the future as needed.

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References

1. Hippel, W., Lerner, J., Gregerman, S., Nagda, B., Jonides, J.: Undergraduate student-faculty research partnerships affect student retention. *Rev. Higher Educ.* **22**, 55–72 (1998)
2. Urizar, G.G., et al.: Advancing research opportunities and promoting pathways in graduate education: a systemic approach to BUILD training at California State University, Long Beach (CSULB). *BioMed Central (BMC) Proceedings* **11**(12), 26–40 (2017)
3. Pontes, M.C.F., Hasit, C., Pontes, N.M.H., Lewis, P.A., Siefring, K.T.: Variables related to undergraduate students' preference for distance education classes. *Online J. Distan. Learn. Adm.* **13**, 1556–3847 (2010)
4. Bosch, N., et al.: Modeling key differences in underrepresented students' interactions with an online STEM course. In: *Proceedings of the Technology, Mind, and Society*. ACM (2018)
5. Doran, G.T.: There's a SMART way to write management's goals and objectives. *Manage. Rev* **70**(11), 35–36 (1981)
6. Bosch, C.G.: Building your Individual Development Plan (IDP): A guide for undergraduate students. *STEM and Culture Chronicle*. SACNAS (2013)
7. Means, B., Toyama, Y., Murphy, R., Bakia, M., Jones, K.: Evaluation of evidence-based practices in online learning: a meta-analysis and review of online learning studies. Washington, D.C.: U.S. Dept. of Education (2009)