NORTH AMERICAN COUNCIL OF AUTOMOTIVE TEACHERS

NACAT News

Destination: Covington, Kentucky

July 12 - 15, 2021

VOL. 34 Fall 2020 NO. 3

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Continued from Summer 2020, Page 34

Success with EASE: Who Benefits from a STEM Learning Community? (Part II)

By: Sabrina Solanki, Peter McPartian, Di Xu, and Brian K. Sato

Methods

Study Context

This study took place at the University of California, Irvine, a public research-intensive university located in the Western United States. It focuses on first-year students in the biological sciences (Bio Sci) major. This study was performed with approval from the University of California, Irvine Institutional Review Board (HS# 2015–2310).

The EASE group consisted of 42.7% (N = 388) of first-year biological sciences majors, grouped into sixteen cohorts. Descriptive data regarding the students who were and were not placed in the EASE program can be found in **Table 1**. As shown in **Table 1**, female students were more likely to get placed in the EASE program. The EASE program also included a larger proportion of students traditionally marginalized in college: 55% of participants belong to a URM group, 63.4% of participants are first-generation college students, and 54.6% come from low-income family households. Lastly, EASE participants earned much lower average SAT-reading and SAT-math scores.

	Full Student Sample		EASE—No		EASE—Yes		
	Mean (%)	SD	Mean (%)	SD	Mean (%)	SD	P value
Female	0.684	(0.465)	0.613	(0.488)	0.780	(0.415)	0.000
White	0.125	(0.331)	0.131	(0.338)	0.116	(0.321)	0.518
URM	0.337	(0.473)	0.177	(0.381)	0.550	(0.498)	0.000
Asian	0.539	(0.499)	0.692	(0.462)	0.333	(0.472)	0.000
First-gen status	0.484	(0.500)	0.372	(0.484)	0.634	(0.482)	0.000
Low-income status	0.407	(0.492)	0.303	(0.460)	0.546	(0.498)	0.000
SAT Reading score (mean)	558.9	(76.45)	581.8	(77.42)	528.2	(63.33)	0.000
SAT Math score (mean)	598.0	(88.48)	653.4	(70.54)	523.9	(45.35)	0.000
N	907		519		388		

Table 1. Demographic data of Bio Sci majors, including those that are and are not in the EASE program. URM consists of Hispanic, African-American, and Native-American students. Differences between students in and not in the EASE program were determined using t-tests with the P value indicated.

https://doi.org/10.1371/journal.pone.0213827.t001

Data Collected

Data collection took a variety of forms, including an online survey instrument implemented at the beginning and end of the fall quarter and a slightly modified version presented at the end of the spring quarter. These surveys measured a variety of student attitudes and behaviors regarding the field of biology, such as sense of belonging, academic and social concerns, academic integration, and interest. All three surveys are provided in the supporting information (S1 File). We briefly describe each construct below.

Belonging in biology assesses the extent to which students feel they belong in the discipline of biology at UCI. Items were adapted from Hoffman's [36] Sense of Belonging Scale to ensure they are specific to the biology discipline instead of to the university in general. This measure includes 8 items; students were asked to indicate how true statements, such as "I have developed personal relationships with other students in my Bio Sci classes" and "I feel comfortable seeking help from

Continued on Page 7

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Online Learning: A Panacea in the Time of COVID-19 Crisis

By: Shivangi Dhawan

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Citation: Dhawan S. Online Learning: A Panacea in the Time of COVID-19 Crisis. Journal of Educational Technology Systems. 2020;49(1):5-22. doi:10.1177/0047239520934018

Abstract

Educational institutions (schools, colleges, and universities) in India are currently based only on traditional methods of learning, that is, they follow the traditional set up of face-to-face lectures in a classroom. Although many academic units have also started blended learning, still a lot of them are stuck with old procedures. The sudden outbreak of a deadly disease called Covid-19 caused by a Corona Virus (SARS-CoV-2) shook the entire world. The World Health Organization declared it as a pandemic. This situation challenged the education system across the world and forced educators to shift to an online mode of teaching overnight. Many academic institutions that were earlier reluctant to change their traditional pedagogical approach had no option but to shift entirely to online teaching–learning. The article includes the importance of online learning and Strengths, Weaknesses, Opportunities, & Challenges (SWOC) analysis of e-learning modes in the time of crisis. This article also put some light on the growth of EdTech Start-ups during the time of pandemic and natural disasters and includes suggestions for academic institutions of how to deal with challenges associated with online learning.

Keywords: coronavirus, COVID-19, education, online learning, technology, EdTech

The deadly and infectious disease Corona Virus also known as Covid-19 has deeply affected the global economy. This tragedy has also shaken up the education sector, and this fear is likely to resonate across the education sector globally. The Covid-19 pandemic outbreak forced many schools and colleges to remain closed temporarily. Several areas are affected worldwide and there is a fear of losing this whole ongoing semester or even more in the coming future. Various schools, colleges, and universities have discontinued in-person teaching. As per the assessment of the researchers, it is uncertain to get back to normal teaching anytime soon. As social distancing is preeminent at this stage, this will have negative effects on learning opportunities. Educational units are struggling to find options to deal with this challenging situation. These circumstances make us realize that scenario planning is an urgent need for academic institutions (Rieley, 2020). This is a situation that demands humanity and unity. There is an urgent need to protect and save our students, faculty, academic staff, communities, societies, and the nation as a whole.

Several arguments are associated with e-learning. Accessibility, affordability, flexibility, learning pedagogy, life-long learning, and policy are some of the arguments related to online pedagogy. It is said that online mode of learning is easily accessible and can even reach to rural and remote areas. It is considered to be a relatively cheaper mode of education in terms of the lower cost of

Continued on Page 8

BOARD CHAIR

STEVE GIBSON

RIVERSIDE, CALIFORNIA

Hello and best wishes NACAT family!

I hope you are having a great Fall semester, in whatever form you may be teaching. Looking back a year, I'm sure no one could have remotely guessed what events would take place to lead us to where we are now. As educators and technicians, we are resilient and don't let problems stand in our way. We search for new tools, new processes, and advice from peers to find a way to break through our barriers and resolve the task at hand.

NACAT exists to broaden your shop manual for being an automotive educator. You can shop for those new educator tools, build and grow your network of peers, and learn how other teachers are working through similar problems.

I hope you had an opportunity to participate in NACAT's Virtual Conference this past July. I want to personally thank our presenters, Donny Seyfer, Scott Brown, John Thornton, Drew Barnes, and Jason Bronsther for bringing us an amazing day of high tech updates, great diagnostic information, insightful information, and a roundtable discussion about the new classroom environment. We had a global audience with an educator joining us from the next day in Australia! NACAT will continue to produce these types of virtual events moving forward, in addition to our traditional Conference and Expo in July.

Speaking of which, work is underway preparing for the 2021 NACAT Conference and Expo in the Cincinnati/Northern Kentucky area, scheduled for July 12-15, 2021. This conference will take place one week earlier than our traditional July dates, so be prepared! Registration information will appear on the NACAT website and Facebook page in the coming months.

Stay safe and enjoy the rest of your Fall semester. 2021 will be here before we know it. Thank goodness!!!

"IF A MAN EMPTIES HIS PURSE INTO HIS HEAD, NO MAN CAN TAKE IT AWAY FROM HIM. AN INVESTMENT IN KNOWLEDGE ALWAYS PAYS THE BEST INTEREST."

Ben Franklin

Continued from Page 3

my Bio Sci teachers before or after class," were true on a 1 (not at all true) to 7 (very true) Likert scale. Cronbach's alpha for the 8 items is equal to 0.85.

Academic and social concerns conveys the extent to which participants worry that other students will dislike them or unfairly evaluate their academic ability [49]. This measure includes 3 items—for example, "In college, I sometimes worry that people will dislike me." Students were asked to respond using the same Likert scale discussed above. Cronbach's alpha for the three items is equal to 0.73.

Academic integration indicates the frequency with which participants engaged in various school-related activities—such as talking to faculty, planning with academic advisors, and attending study groups—during their first term on campus. This measure included 5 items. Cronbach's alpha is equal to 0.60.

Interest in biology is a measure inspired by the Eccles' [50] Expectancy-Value Model of motivation, which is a critical means of evaluating how much students value a field of study. Individual items were adapted from Harackiewicz's [51] and include, for example, "I think the field of Biology is very interesting." This measure included 3 items. Cronbach's alpha for the 3 items is equal to 0.91.

Student demographic data—including gender, ethnicity, first-generation status, low-income status,

Continued on Page 12

Continued from Page 5

transportation, accommodation, and the overall cost of institution-based learning. Flexibility is another interesting aspect of online learning; a learner can schedule or plan their time for completion of courses available online. Combining face-to-face lectures with technology gives rise to blended learning and flipped classrooms; this type of learning environment can increase the learning potential of the students. Students can learn anytime and anywhere, thereby developing new skills in the process leading to life-long learning. The government also recognizes the increasing importance of online learning in this dynamic world.

The severe explosion of Corona Virus disease can make us add one more argument in terms of online learning, that is, online learning serves as a panacea in the time of crisis.

Literature Review

Online Learning or E-Learning

Rapid developments in technology have made distance education easy (McBrien et al., 2009). "Most of the terms (online learning, open learning, web-based learning, computer-mediated learning, blended learning, m-learning, for ex.) have in common the ability to use a computer connected to a network, that offers the possibility to learn from anywhere, anytime, in any rhythm, with any means" (Cojocariu et al., 2014).Online learning can be termed as a tool that can make the teaching–learning process more student-centered, more innovative, and even more flexible. Online learning is defined as "learning experiences in synchronous or asynchronous environments using different devices (e.g., mobile phones, laptops, etc.) with internet access. In these environments, students can be anywhere (independent) to learn and interact with instructors and other students" (Singh & Thurman, 2019). The synchronous learning environment is structured in the sense that students attend live lectures, there are real-time interactions between educators and learners, and there is a possibility of instant feedback, whereas asynchronous learning environments are not properly structured. In such a learning environment, learning content is not available in the form of live lectures or classes; it is available at different learning systems and forums. Instant feedback and immediate response are not possible under such an environment (Littlefield, 2018). Synchronous learning can provide a lot of opportunities for social interaction (McBrien et al., 2009). Amidst this deadly virus spread such online platforms are needed where (a) video conferencing with at least 40 to 50 students is possible, (b) discussions with students can be done to keep classes organic, (c) internet connections are good, (d) lectures are accessible in mobile phones also and not just laptops, (e) possibility of watching already recorded lectures, and (f) instant feedback from students can be achieved and assignments can be taken (Basilaia et al., 2020).

Online Teaching Is No More an Option, It Is a Necessity

The major part of the world is on quarantine due to the serious outbreak of this global pandemic Covid-19 and therefore many cities have turned into phantom cities and its effects can be seen in schools, colleges, and universities too. Betwixt all this online teaching and online learning can be termed as the panacea for the crisis. The Corona Virus has made institutions to go from offline mode to online mode of pedagogy. This crisis will make the institutions, which were earlier reluctant to change, to accept modern technology. This catastrophe will show us the lucrative side of online teaching and learning. With the help of online teaching modes, we can sermonize a large number of students at any time and in any part of the world. All institutions must scramble different options of online pedagogical approaches and try to use technology more aptly. Many universities around the

Continued on Page 11

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Fellow NACAT Members,

As I sit down to compose this update much has changed in the world since my spring report. We are all experiencing a new normal and it is my hope that each of you is safe and well.

When I composed my update for the spring issue everything was still normal and I expected to see everyone's smiling face in Cincinnati in July. Obviously COVID 19 and the national health emergency changed those plans. Most of us finished the spring term teaching remotely and in many cases summer classes were removed from the schedule completely. The Board and Officers met in May and made the decision to make the health and safety of our members, presenters, and vendors a top priority and postpone our in-person conference for 2020. At the same time, plans were created to hold a one-day virtual conference in its place.

The one-day virtual conference that NACAT hosted on July 23rd was a huge success. All four online sessions were well attended. Thank you to the many NACAT members who were in attendance. We also had many non-members in attendance. These instructors got an opportunity to what NACAT was all about and hopefully we will see them at an in-person event soon. Many thanks to our presenters, John Thornton, Donny Seyfer, Scott Brown, Jason Bronsther, and Drew Barnes. I also want to thank the sponsors of our virtual conference. AES, Consulab, Electude, CCAR, and Mitchell 1 provided the financial support that allowed us to enjoy these fantastic presentations. Based on the success of this event NACAT is hosting a series of online events in the coming months. Look for announcements in your email.

The 2020 conference in Covington, Kentucky has been postponed until July 12-15, 2021. We are grateful for the efforts of the Northern Kentucky Conference Center and the Cincinnati Marriott River Center who have worked with us to make this postponement possible. Please note that these dates are earlier in the month of July than we usually meet. The Board and officers continue their work to refresh the look of the conference and expo and look forward to sharing it with you next summer. The conference committee has worked hard to optimize the conference and expo schedule so that each participant can continue to receive 20 hours of training, enjoy an exciting expo, and take advantage of the best travel opportunities. Look for these changes when conference registration opens later this year.

In closing, I ask each of you to complete two tasks. First, renew your NACAT membership if you have not already done so. Second, save the dates of July 12-15 on your calendar for the 2021 conference. Have a great fall term, no matter what the format, and know that you are making a positive impact on the automotive technicians of the future.

Continued from Page 8

world have fully digitalized their operations understanding the dire need of this current situation. Online learning is emerging as a victor ludorum amidst this chaos. Therefore, the quality enhancement of online teaching–learning is crucial at this stage. Online education in Chinese universities has increased exponentially after the Covid-19 outbreak. There was an overnight shift of normal classrooms into e-classrooms, that is, educators have shifted their entire pedagogical approach to tackle new market conditions and adapt to the changing situations. During this tough time, the concern is not about whether online teaching–learning methods can provide quality education, it is rather how academic institutions will be able to adopt online learning in such a massive manner (Carey, 2020).

Resistance to change will not help any educational unit across the world. They will be judged on their pace to adapt to the changes in such a short period and their ability to maintain the quality. The reputation of educational units is on stake and under scrutiny. How well they behave and how well they maintain their quality of education amidst this crisis shows their adapting capabilities. The shift from face-to-face lectures to online classes is the only possible solution. Indeed, academic institutions would not be able to transform all of their college curricula into and online resource overnight. Distance, scale, and personalized teaching and learning are the three biggest challenges for online teaching. Innovative solutions by institutions can only help us deal with this pandemic (Liguori & Winkler, 2020). There is a requirement of a quick shift to online learning mode; therefore, the products by Google can be really useful under such problematic situations; they are (a) Gmail, (b) Google Forms, (c) Calendars, (d) G-Drive, (e) Google Hangouts, (f) Google Jam board and Drawings, (g) Google Classroom, and (h) Open Board Software (not a Google product, helps in recording meetings in the form of files). These tools can successfully be used as an alternative for face-to-face classes (Basilaia et al., 2020).

Problems Associated With Online Teaching and Learning

There are n number of technologies available for online education but sometimes they create a lot of difficulties. These difficulties and problems associated with modern technology range from downloading errors, issues with installation, login problems, problems with audio and video, and so on. Sometimes student finds online teaching to be boring and unengaging. Online learning has so much of time and flexibility that students never find time to do it. Personal attention is also a huge issue facing online learning. Students want two-way interaction which sometimes gets difficult to implement. The learning process cannot reach its full potential until students practice what they learn. Sometimes, online content is all theoretical and does not let students practice and learn effectively. Mediocre course content is also a major issue. Students feel that lack of community, technical problems, and difficulties in understanding instructional goals are the major barriers for online learning (Song et al., 2004). In a study, students were found to be not sufficiently prepared for balancing their work, family, and social lives with their study lives in an online learning environment. Students were also found to be poorly prepared for several e-learning competencies and academic-type competencies. Also, there is a low-level preparedness among the students concerning the usage of Learning Management Systems (Parkes et al., 2014).

Possible Solutions for Problems

A lot of issues are attached to online education but we cannot ignore the perks of it in times of such crisis. We can always have solutions to fix these difficulties. Technical difficulties can be solved through prerecording video lectures, testing the content, and always keeping Plan B ready

Continued on Page 13

Article: EASE

Continued from Page 7

SAT Reading score, and SAT (or ACT equivalent) Math score—was collected from the campus registrar. We also collected student outcome data that includes information about course performance in two first-year biology courses: Bio Sci 93, an introductory course that covers biology basics, and Bio Sci 94, the follow-up course. Data regarding first-year overall GPA and retention within the biological sciences major at the end of the first year was also collected and included in the analysis as student outcome measures.

Data Analysis

To explore the relationship between the EASE program and student academic and nonacademic outcomes, we use an ordinary least squares (OLS) estimation strategy in which EASE is the

$$Y_i = \beta_0 + \beta_1(EASE_i) + X_i + \mu_i \qquad \text{equation 1}$$

key explanatory variable and is equal to 1 if the student participated in the program; X_i includes demographic characteristics (e.g., gender, race, first-generation status, and low-income status) and academic preparedness characteristics (e.g., SAT section scores). μ_i is the error term.

Additionally, we explore whether gaps in academic achievement and in the social-psychological measures are wider or narrower for certain student subgroups. For this aspect of analysis, we include an interaction term between a given individual attribute (such as 'female') and EASE status in Eq 1. We present the formal equation below. For all analyses, robust standard errors were used.

$$Y_i = \beta_0 + \beta_1(EASE_i) + \beta_2(Attribute_i) + \beta_3(EASE_i * Attribute_i) + X_i + \mu_i \qquad \text{equation 2}$$

We report the β_1 coefficient, which indicates the impact of EASE on the reference group (for example, male students), and the β_3 coefficient, which indicates whether EASE reduced the academic achievement gap

Continued on Page 17

Continued from Page 11

so that the teaching–learning process cannot be hampered. Online courses should be made dynamic, interesting, and interactive. Teachers should set time limits and reminders for students to make them alert and attentive. Efforts should be made to humanize the learning process to the best extent possible. Personal attention should be provided to students so that they can easily adapt to this learning environment. Social media and various group forums can be used to communicate with students. Communication is the key when it gets difficult to try reaching out to students via texts, various messaging apps, video calls, and so on—content should be such that enable students for practice and also hone their skills. The quality of the courses should be improved continuously and teachers must try to give their best. Online programs should be designed in such a way that they are creative, interactive, relevant, student-centered, and group-based (Partlow & Gibbs, 2003). Educators must spend a lot of time in making effective strategies for giving online instructions. Effective online instructions facilitate feedback from learners, make learners ask questions, and broaden the learner horizon for the course content (Keeton, 2004). Institutions must focus on pedagogical issues and emphasize collaborative learning, case learning, and project-based learning through online instructions (Kim & Bonk, 2006).

The challenge to educational institutions is not only finding new technology and using it but also reimagining its education, thereby helping students and academic staff who are seeking guidance for digital literacy.

Objectives of the Study

1. To explore the growth of EdTech Start-ups and online learning.
2. To conduct an Strengths, Weaknesses, Opportunities, & Challenges (SWOC) analysis of online learning during the Corona Virus pandemic and natural disasters.
3. To give some suggestions and recommendations for the success of online mode of learning during a crisis-like situation.

Research Methodology

The study is descriptive and tries to understand the importance of online learning in the period of a crisis and pandemics such as the Covid-19. The problems associated with online learning and possible solutions were also identified based on previous studies. The SWOC analysis was conducted to understand various strengths, weaknesses, opportunities, and challenges associated with online mode of learning during this critical situation. The research tool used for analyzing the data which amassed from different sources for this study is a content analysis and the research method is descriptive research. We have taken into consideration the qualitative aspects of the research study. This study is completely based on the secondary data. A systematic review was done in detail for the collected literature.

Secondary sources of data used are (a) journals, (b) reports, (c) search engines, (d) company websites and scholarly articles, (e) research papers, and other academic publications.

EdTech Start-ups in the Times of Corona

If we go back in history and see EdTech through the ages, we can observe that writing slates were used in Indian schools during the 1100s. In the year 1440, first printing press was invented by Johannes Guttenberg; in the 1600s, Abacus helped students in understanding fundamentals

Continued on Page 14

Continued from Page 13

of Math; and in the year 1913, Thomas Edison promoted film clips as a replacement for teachers. In 1927, Sidney Pressy invented the first teaching machine famously called the MCQ machine. In the 1960s, online education originated at the University of Illinois and in 1994, India's EdTech journey finally began in India with the launch of Educomp. Recently, around 2010, EdTechs start-ups entered the market intending to disrupt the education sector. A learning application Byju's became one of the most valued EdTech companies in the year 2019. And from then many start-ups have come up to give tough competition to Byjus's. Li Kang, Ai English Executive Director said, "Online Learning is the future and if there was no virus, that realization would have taken another few years but this has accelerated the process."

EdTech Start-ups are tapping all the right opportunities by providing free online courses to students amidst this crisis. UNESCO also suggested that these EdTech Start-ups and learning apps can help students during such hard times. Digital payment companies, such as Paytm, Mobiwik, Tez, PhonePe, and so on, grew rapidly during and after demonetization. Now, in this pandemic outbreak, EdTech start-ups are hoping for improved performance. EdTech start-ups are trying hard to make most out of this situation by providing several free courses and e-resources to the students. Although the availability of electricity and a stable internet connection is still a bigger challenge in their way as a lot of Indian cities especially small cities still face frequent electricity shortages. As per the reports, initiatives by these companies are already bringing them gains. Their customer base is improving a lot, it might be for a temporary period but even if they can retain a few customers it is for their good only.

Educators or teachers in the form of facilitators face a lot of trouble while working on these EdTech start-ups in the form of how to start using it when to use it, how to reduce distractions for students, how to hone students' skills via EdTech. The participation by students is not enough, educators must put considerable effort to increase student engagement, retain their attention, take feedbacks, and assess them in several ways. This will create an effective and meaningful learning environment. EdTech cannot replace a teacher but it can enhance instruction. During such tough times, when Covid-19 has forced schools and colleges to remain completely lockdown for few weeks due to the seriousness of the situation, EdTech companies can prove to be of great help to students (Brianna et al., 2019). According to the reports by KPMG and Google, the EdTech sector will boom and is likely to reach around 2 Billion Dollars by 2021. Some of the famous EdTech start-ups include Byju's, Adda247, Alolearning, AptusLearn, Asmakam, Board Infinity, ClassPlus, CyberVie, Egnify, Embibe, ExtraaEdge, iStar, Jungroo Learning, GlobalGyan, Lido Learning, Pesto, Vedantu, Edubrisk, ZOOM Classroom, ZOOM Business, Toppr, Unacademy, Coursera, Kahoot, Seesaw, Khan Academy, e-pathshala, GuruQ, and the list is long. SWAYAM portal is an interesting educational program that is initiated by the government of India to achieve three important objectives of our educational policy, that is, access, equity, and quality. The main objective of SWAYAM is to provide online learning and reduce the digital divide. It provides a large number of free courses for school, distance, graduate, and postgraduate education. During the Covid-19 crisis, SWAYAM is of great help for students across the country.

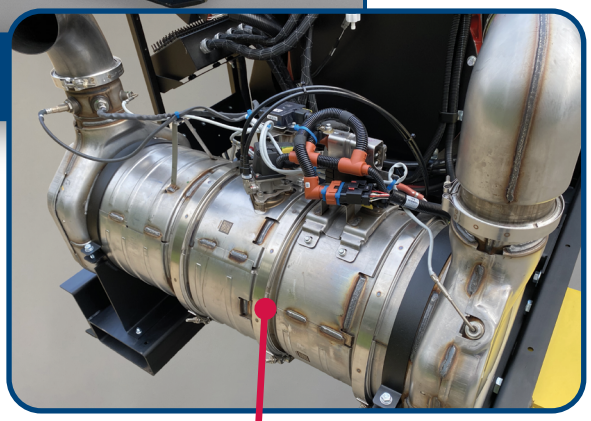
SWOC Analysis of Online Learning: During Corona Virus Pandemic and Other Crisis-Like Situation (Natural Disasters)

In the aftermath of some of the natural calamities such as floods, cyclones, earthquakes, hurricanes, and so on, knowledge delivery becomes a challenging task. These hazards disrupt the educational processes in schools and colleges in several ways. Sometimes, it leads to closure of schools

Continued on Page 16

Diesel Engine Performance Trainer

Model 650HD



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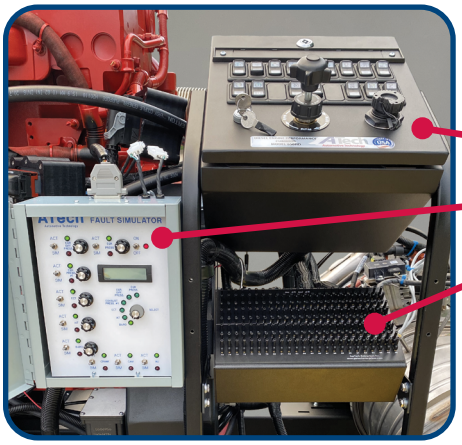

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Article: Online Learning

Continued from Page 14

and colleges which creates serious consequences for students and deprives them of their fundamental right to education and poses them to future risk. “100 million children and young people are affected by natural disasters every year. Most of them face disruption to their schooling” (World Vision). Situations of crisis and conflicts are the biggest hurdles in the path of education. Many students and teachers also face psychological problems during crisis—there is stress, fear, anxiety, depression, and insomnia that lead to a lack of focus and concentration. Disasters create havoc in the lives of people (Di Pietro, 2017).

With changing weather patterns and rising global temperatures, an increasing number of extreme weather events have become the new norm. Such events caused varying amounts of loss to life and property. **Table1**, page 22, shows some of the natural disasters that caused huge disruption in educational processes. Large numbers of schools and colleges were destroyed and thousands of students were affected by these natural calamities. Their education got disrupted in midway. “Disruption of education can leave children at risk of child labor, early marriage, exploitation, and recruitment into armed forces” (Baytiyeh, 2018). When disasters and crises (man-made and natural) occur, schools and colleges need to be resilient and should find new ways to continue with teaching–learning activities (Chang-Richards et al., 2013).

For instance, in 2016, Italy experienced three violent and powerful earthquakes. This brought huge devastation in the number of areas. About 1,00,000 people became homeless, buildings and

Continued on Page 18

Continued from Page 12

(or in the case of gender, the gender achievement gap). We run a separate regression conditioning on the student attributes using Eq (1). Where noted, missing values have been adjusted using a dummy variable approach [52].

Results

Impact of EASE on Student Performance Outcomes

We first wanted to identify whether participation in the EASE program is correlated with improved student outcomes. **Table 2** provides the results for a number of these academic outcomes, including performance in freshman biology courses, first-year cumulative GPA, and retention within the biological sciences major for students who were and were not in the EASE program. When controlling for a variety of demographic characteristics, we find that enrollment in the EASE program is correlated with significantly higher grades in Bio Sci 94–0.38 grade points higher on a 0–4 point scale—and a 0.24 boost in first-year GPA.

	Bio Sci 93 course grade	Bio Sci 94 course grade	Year 1 GPA	Retained
EASE	-0.055	0.380***	0.242***	0.013
	(0.085)	(0.088)	(0.057)	(0.026)
Female	-0.047	-0.144**	-0.005	-0.032**
	(0.065)	(0.063)	(0.044)	(0.015)
URM	-0.153	-0.225**	-0.163***	-0.043
	(0.094)	(0.088)	(0.063)	(0.031)
Asian	-0.185**	-0.202**	-0.142**	0.021
	(0.087)	(0.080)	(0.059)	(0.025)
First-gen status	0.020	-0.037	-0.029	0.004
	(0.066)	(0.070)	(0.046)	(0.017)
Low-income status	-0.027	0.010	-0.003	0.022
	(0.067)	(0.070)	(0.046)	(0.018)
SAT Reading score	0.003***	0.003***	0.002***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
SAT Math score	0.003***	0.003***	0.002***	0.000
	(0.001)	(0.001)	(0.000)	(0.000)
N	903	853	839	899

Table 2. Robust standard errors in included in parentheses. The reference group White. Course grade and GPA estimates use a 0–4 point scale. Missing values have been adjusted using a dummy variable approach.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$.

https://doi.org/10.1371/journal.pone.0213827.t002

As discussed earlier, the purpose of our study is to better understand whether certain student subgroups (e.g., URM students, female students, and first-generation students) benefit particularly from the learning community experience, with the results of our analysis found in **Table 3 (page 21)**. Using gender as an example, both male and female EASE students earned higher Bio Sci 94 grades than their non-EASE counterparts did (column 2). Specifically, male EASE students and female EASE students earned grades 0.53 and 0.34 grade points higher (on a 0–4 point scale), respectively, than their non-EASE counterparts. However, the β_3 coefficient, EASE*Female, is not significant. Thus, the gender achievement gap in the EASE sample is not significantly different than that in the non-EASE sample.

In terms of race, all three student subgroup populations benefited from the EASE program. White students, URM students, and Asian students earned Bio Sci 94 grades that were 0.48, 0.41, and

Continued on Page 21

Continued from Page 16

structures collapsed, and there was severe loss of life and property. The University of Camerino, one of the oldest universities in the world suffered a huge loss. The university was in crisis, its structure collapsed, a large number of students became homeless and some left the place. In such situations, students were deprived of education and learning. It is rightly said, “It is difficult to stick to the traditional road when the road itself has crumbled.” This means that face-to-face instructions were not possible at that time; therefore, management and leaders came forward to devise some plans to keep the educational processes in continuation. Before the earthquake’s destruction, e-learning at the University was cumbersome. But they were unstoppable, and to continue the teaching–learning processes, they used Webex (an online tool) by Cisco. Webex helped professors in designing their instructional programs and sharing notes and presentations with students. In almost 1 month, the university was well-versed with e-learning strategies and techniques. They integrated themselves well in an e-learning world. They believed that, of course, the value of the face-to-face instruction method cannot be reduced, but e-learning can be used together with the traditional methods to bring in efficiency, effectiveness, and competitive edge over other competitors by imparting quality education (Barboni, 2019).

In February 2011, a 6.3 magnitude earthquake shook Christchurch and the University of Canterbury collapsed. Information technology and online learning helped the university to restart its operations and gave them a second life (Todorova & Bjorn-Andersen, 2011).

At New Orleans, Southern University converted itself into an e-learning campus after the violent hurricane created a Havoc. Several online courses were offered and mobiles were used to provide education to the displaced students (Omar et al., 2008).

And the most recent disaster is in the form of the Covid-19 which is spreading like a forest fire around the world. All of the schools, colleges, and universities are facing lockdowns in the most affected areas to curb further spread of the Corona Virus. Many academic institutions are, therefore, seeking the help of online learning so that teaching and learning processes are not hampered. The SWOC Analysis of Online Learning is shown in **Figure 1**.

In the last few years, e-learning has started gaining popularity in India. Many platforms provide affordable courses to students via Massive Open Online Courses. Still a lot of institutions in India were reluctant toward online teaching and learning. However, the challenges posed by the Corona Virus pandemic introduced everyone to a new world of online learning and remote teaching. Instructors indulged them in remote teaching via few flatforms such as Google Hangouts, Skype, Adobe Connect, Microsoft teams, and few more, though ZOOM emerged as a clear winner. Also, to conduct smooth teaching–learning programs, a list of online etiquettes was shared with students and proper instructions for attending classes were given to them (Saxena, 2020).

Authors’ Note

Below are the sites of different educational portals which I referred to while knowing what types of courses they offer & two of them are news articles as COVID is currently in the news.

https://www.ft.com/ | https://swayam.gov.in/explorer | https://bolog.zoom.us/ | https://byjus.com/ | https://economictimes.indiatimes.com/small-biz/startups/features/covid-19-cities-lockdown-zoom-video-calling-app-videoconferencing-google-hangout-skype/articleshow/74767206.cms | https://www.usatoday.com | https://www.wvi.org/education-and-life-skills/education-emergencies (World Vision)

Continued on Page 22

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Catch a Wave!

Written By Curt Ward

CHANGE IS NOW!

If you are like most instructors, you spent the last month of summer working to transform your curriculum into a format that would suit a new normal for the fall. Depending on where you are in the country, it will look a little different or completely transformed. One of the main conversations I have heard over the last few months is that "when you make changes to your program to meet COVID-19 requirements, make sure you consider your program in the long term". I could not agree more. This is a great time to "tune up" your curriculum so it is ready for the changes coming in our industry. I believe the new look in our industry is going to include a significant increase in vehicle electrification. If you don't believe me, just look at the number of vehicles on the market today that are equipped with stop – start technology. These micro/mild hybrids are prime examples of the changes in vehicle electrification. Now that you are in agreement, what changes in your curriculum should you be considering?

Let's begin with vehicle safety. Are you including hybrid and electric vehicle safety in your curriculum? High voltage safety should be included in any program; no matter what the certification level. Specific tasks should include the recognition of high voltage cables and the process for safely depowering the high voltage system. Additional tasks should include the process for safely testing and using high voltage gloves and other personal protective equipment. Your students will be amazed to discover gloves come in sizes other than small, medium, and large. Your students need to be able to identify and safely remove high voltage disconnect or interlock. This hands-on task will allow your students to experience using the high voltage gloves and safely depower the high voltage system. Even if all you teach is safety, your students will be better prepared to operate safely when they work on other systems on the car.

Equally important, is the proper use of service information. This is a topic that needs to be taught; not just included with other topics. It does not matter if your program has access to factory service information or aftermarket service information this is still an important skill. Like any other skill, it must be practiced to be perfected. There are so many resources today that it can become overwhelming. A student needs to be instructed on what to use and where to find the needed information to make the correct repair. Unfortunately, not all manufacturers use the same methodology for creating their service information and this can be an enormous task to cover. The benefit is that having the correct information is the first step to having a successful repair.

The next area that should be reviewed is Electrical. Many of you are teaching Electrical I and Electrical II. Is it time for Electrical III? When we think about vehicle electrification, topics like power output in watts and loss of isolation come to mind. More importantly, does your electrical content include capacitors, magnetic force, three phase circuits and IGBT transistors? Do the lab activities include mille-ohm and mega-ohm measurements? Are you teaching high speed CAN network, scope testing, and module reprogramming? These are all topics that need to be included in the curriculum as we move forward into vehicle electrification. Most of your Electrical I and II courses are jam packed and there is no room to add any more content. An Electrical III course may be just the place for this content and these types of activities.

Continued on Page 26

Continued from Page 17

0.38 grade points higher, respectively, than those of their non-EASE counterparts. Again, we do not find a significant interaction term (EASE*URM) to indicate that the racial achievement gap decreases given EASE involvement. Overall, whereas groups of students traditionally less-represented in STEM (e.g., female, URM, first generation, and low-income) saw gains in Bio Sci 94 grades and first-year cumulative GPA, these gains are not greater than those observed for their non-at-risk counterparts (**Table 3**).

		(1) Biology 93 course Grade		(2) Biology 94 course Grade		(3) Year 1 GPA		(4) Retained	
Gender									
Full-sample estimates									
	EASE (Male)	-0.113	(0.169)	0.525	(0.168)***	0.339	(0.114)***	-0.037	(0.034)
	EASE*Female	0.111	(0.196)	-0.167	(0.199)	-0.114	(0.133)	0.077	(0.048)
Subsample estimates									
	Male (N = 276)	-0.113	(0.170)	0.525	(0.169)***	0.339	(0.115)***	-0.037	(0.035)
	Female (N = 602)	-0.002	(0.099)	0.357	(0.106)***	0.225	(0.067)***	0.040	(0.034)
Race									
Full-sample estimates									
	EASE (White)	-0.014	(0.215)	0.475	(0.181)***	0.367	(0.132)***	-0.001	(0.071)
	EASE*URM	0.114	(0.248)	-0.070	(0.233)	-0.089	(0.160)	0.066	(0.086)
	EASE*Asian	-0.121	(0.252)	-0.093	(0.227)	-0.141	(0.159)	-0.008	(0.077)
Subsample estimates									
	White (N = 110)	-0.014	(0.220)	0.475	(0.185)**	0.367	(0.135)***	-0.001	(0.073)
	URM (N = 297)	0.100	(0.124)	0.405	(0.147)***	0.278	(0.091)***	0.066	(0.049)
	Asian (N = 471)	-0.135	(0.131)	0.382	(0.137)***	0.226	(0.088)**	-0.009	(0.030)
First-generation status									
Full-sample estimates									
	EASE	0.104	(0.119)	0.593	(0.135)***	0.334	(0.088)***	0.043	(0.041)
	EASE*First-gen status	-0.228	(0.173)	-0.330	(0.182)*	-0.121	(0.118)	-0.039	(0.054)
Subsample estimates									
	Continuing-gen status (N = 446)	0.104	(0.119)	0.593	(0.135)***	0.334	(0.088)***	0.043	(0.041)
	First-gen status (N = 432)	-0.124	(0.125)	0.263	(0.122)**	0.214	(0.078)***	0.005	(0.035)
Low-income status									
Full-sample estimates									
	EASE	0.125	(0.103)	0.601	(0.117)***	0.318	(0.076)***	0.072	(0.037)*
	EASE*Low-income status	-0.339	(0.172)**	-0.435	(0.180)**	-0.135	(0.118)	-0.113	(0.051)**
Subsample estimates									
	Low-income status = 0 (N = 514)	0.125	(0.103)	0.601	(0.117)***	0.318	(0.076)***	0.072	(0.037)*
	Low-income status = 1 (N = 364)	-0.214	(0.137)	0.167	(0.136)	0.183	(0.090)**	-0.041	(0.035)

Table 3. Robust standard errors in included in parentheses. All models include the following student controls: female, URM, Asian, first-generation status, low-income status, SAT Reading score, SAT Math score. The reference group is White. Course grade and GPA estimates are reported using a 0–4 point scale. Missing values have been adjusted using a dummy variable approach.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$.

https://doi.org/10.1371/journal.pone.0213827.t003

Impact of EASE on Social-Psychological Measures of the Student Experience

Learning communities are considered a way to not only alleviate academic issues common among at-risk students, but also further students' social psychological well-being, positively affecting their sense of belonging, academic and social concerns, academic integration, and interest in science. As shown in **Table 4 (page 25)**, we find that student involvement in EASE is correlated with statistically significant higher levels of sense of belonging and academic integration at the end of students' first term in college. Specifically, EASE students reported values for sense of belonging and academic integration that were 0.21 and 0.32 standard deviation units larger, respectively, than those reported by non-EASE students.

Continued on Page 25

Continued from Page 18

Year	Natural disasters
2009	A violent earthquake in 9 the city of L'Aquila
2010	Floods in Pakistan
2011	Tropical storm Washi in the Philippines
2011	A series of earthquakes in New Zealand
2013	Tropical storm Haiyan in the Philippines
2015	Gorkha floods in Nepal
2017	Harvey and Irma Hurricanes in the United States
2017	Floods in Nepal, Bangladesh, and India
2018	An earthquake in Papua New Guinea
2018	Earthquakes and tsunamis in Indonesia
2019	The typhoon Lekima in China
2019	The typhoon Hagibis in Japan
2019	The tropical cyclone Idai in Southeastern Africa
2019	The heat wave in Bihar

Source. Save the Children (2014, 2017), US News and World Report, & Briggs, 2018.

Table 1: Natural Disaster That Affected Teaching – Learning Badly.

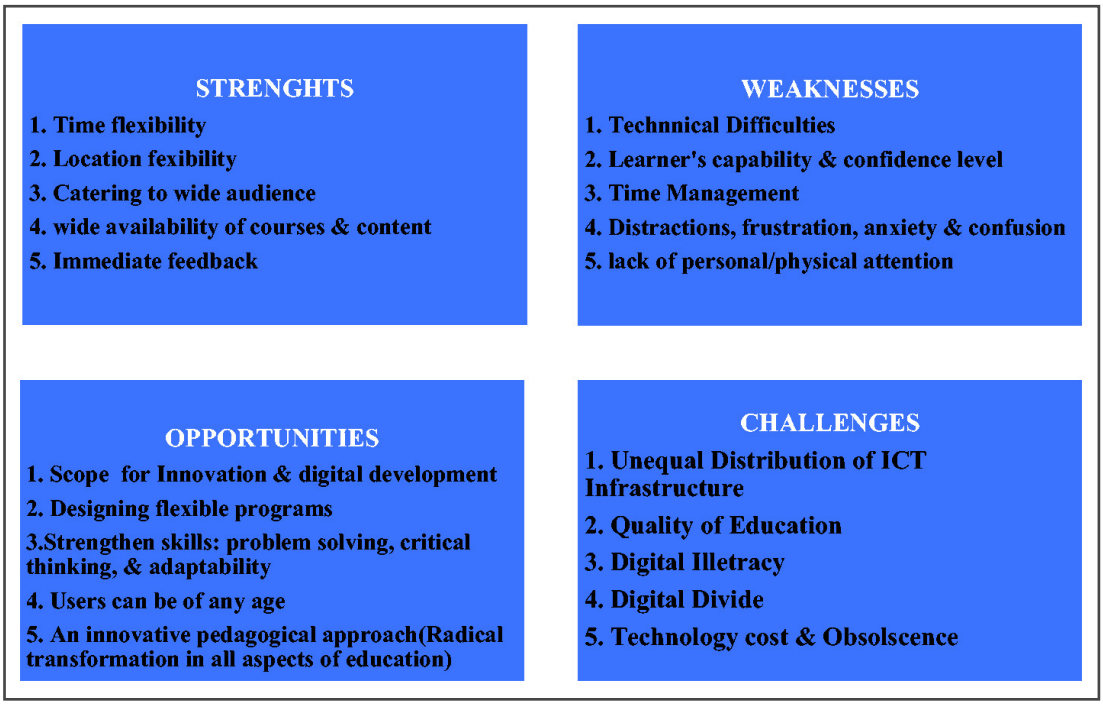

Figure 1. The SWOC Analysis of Online Learning During Such Crises.

Note: SWOC = Strengths, Weaknesses, Opportunities, & Challenges.

Strengths

E-learning methods and processes are really strong. These strengths of the online learning modes can rescue us from these hard times. It is student-centered and offers a great deal of flexibility in terms of time and location. The e-learning methods enable us to customize our procedures and processes based on the needs of the learners. There are plenty of online tools available which is important for an effective and efficient learning environment. Educators can use a combo of audio, videos, and text to reach out to their students in this time of crisis to maintain a human touch to their lectures. This can help in creating a collaborative and interactive learning environment where students can give their immediate feedback, ask queries, and learn interestingly. The Anywhere-Anytime feature of e-learning is beneficial in the times of crisis-like situation, for instance, man-made disasters, natural disasters, or pandemics such as Covid-19. The closure of places and unsafe traveling by roads can

Continued on Page 28

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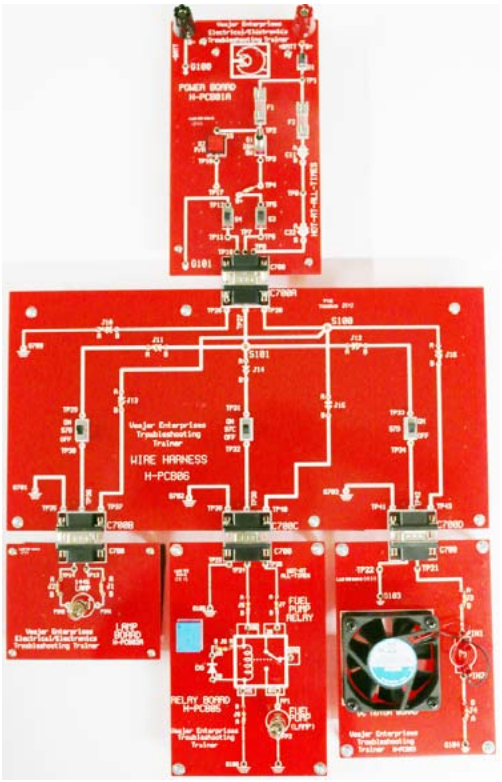

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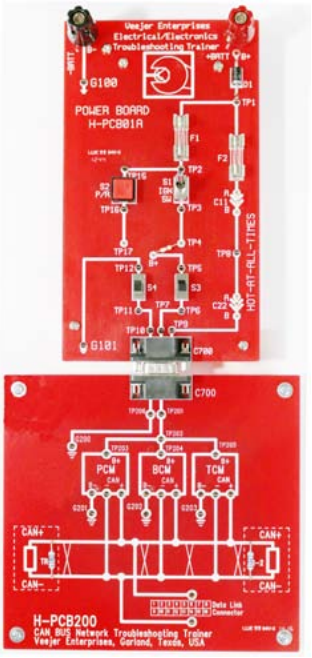

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Continued from Page 21

	(1) Sense of Belonging	(2) Academic & Social Concerns	(3) Academic Integration	(4) Academic Interest
EASE	0.206**	0.077	0.322***	-0.057
	(0.080)	(0.072)	(0.110)	(0.083)
Female	0.043	0.055	-0.052	-0.020
	(0.063)	(0.053)	(0.076)	(0.067)
URM	-0.109	-0.048	-0.107	0.075
	(0.105)	(0.082)	(0.130)	(0.109)
Asian	-0.046	0.056	-0.130	0.011
	(0.094)	(0.074)	(0.113)	(0.096)
First-gen status	0.054	-0.106*	-0.093	0.018
	(0.067)	(0.059)	(0.080)	(0.067)
Low-income status	0.027	-0.000	-0.023	0.117*
	(0.060)	(0.057)	(0.078)	(0.065)
SAT Reading score	-0.000	-0.000	-0.002***	0.002***
	(0.000)	(0.000)	(0.001)	(0.001)
SAT Math score	0.002***	0.000	0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)
N	832	834	864	829

Table 4. Robust standard errors in included in parentheses. Dummy variable approach to missing values used. All items measured at the end of the fall quarter and standardized to have a mean of 0 and a standard deviation of 1. All models include a pre-score. For Academic and Social Concerns, higher values indicate more concern.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$.

https://doi.org/10.1371/journal.pone.0213827.t004

Similar to our efforts to analyze academic outcomes, we explore the possibility of heterogeneous treatment effects. As shown in **Table 5 (page 30)**, we find significant differences in values regarding sense of belonging reported by female students in EASE and female students not in EASE. Specifically, female EASE students reported values for the sense of belonging measure that were 0.18 standard deviation units higher than the values reported by female students not in EASE. This impact is even more pronounced for the measure of academic integration, with female EASE students reporting values that were 0.44 standard deviation units larger than those reported by non-EASE female students. Additionally, for the measure of academic integration, the interaction term EASE*Female is positive and marginally significant, indicating that the large increase for female students is responsible for a gender gap that favors female students.

Male students reported social-psychological outcome measure values larger than those reported by their non-EASE counterparts only for the measure of academic and social concerns. The positive coefficient, however, indicates that male EASE students reported having more concerns than their non-EASE counterparts.

Of the three different race groups, Asian students seemed most affected by EASE. Specifically, the coefficients indicate that Asian students in EASE experienced a greater sense of belonging ($\beta_1 = 0.32$) and engaged in behaviors that indicated they were more academically integrated within the major ($\beta_1 = 0.43$). EASE did not have similarly significant effects for White and URM students. Lastly, first-generation students in EASE reported being more concerned about their academic ability than their non-EASE counterparts. However, these same students reported much higher values for the item measuring academic integration ($\beta_1 = 0.41$). Low-income students in EASE also reported much higher values for the academic integration measure than their non-EASE counterparts ($\beta_1 = 0.48$).

Continued on Page 30

Continued From Page 20

This is a great time to update the balance of your curriculum. The changes may be minor, but they can make a big impact on what the students will need to know in the future. The steering and suspension curriculum is a great example. Make sure electric power steering is covered. In addition to covering theory and operation, make sure the students are comfortable with diagnosis and calibration. Without calibration, it is becoming increasingly impossible to perform an alignment. Included in this topic would be features related to the advanced driver assistance systems. As we move into electrification these features are becoming standard. When covering ABS brakes are you including the topic of regenerative braking? This is an area that needs to be expanded to include topics like system operation, battery charging, and deceleration rates. The lab activities may need to be updated to reflect any specific service procedures associated with these systems. The chassis portion of the curriculum has become increasingly more electrical and we need to have updated curriculum and potentially new tools and equipment to support these changes.

An area of the curriculum that may need significant updating to support vehicle electrification is heating and air conditioning. Most of our hybrid and electric vehicles have multiple cooling systems and many have supplemental methods of providing heat. The heating and cooling responsibilities have expanded from the engine and the passenger compartment to include high voltage components such as inverters, converters, and the high voltage battery. The air conditioning compressor is most likely a high voltage system component and uses special refrigerant oil. These systems require unique service procedures, more frequent service, and special tools in order to maintain proper operation.

Most programs include preventative maintenance service early in the curriculum. Are hybrid and electric vehicles included in this topic? Routine service for these vehicles is an item that is often overlooked by the customer and the service industry. Oil changes, cooling system service and braking system service are all procedures that a student can perform if they have the proper instruction.

To this point, I have not covered the topics that would be included in a typical hybrid and electric vehicle class, or a class that covers advanced driver assistance systems. These are classes that are going to require significant changes to curriculum if they are to be covered during the same timeframe. Perhaps these topics can be covered in a capstone class. The topics I have covered in this article are primarily changes that need to be made to current curriculum so the student is prepared to service the vehicles that are on the road today. As you are reviewing the curriculum for needed changes, start making a list of tools you are going to need to support these changes. Some may be small; others may be much more significant. As you move forward in this process, get your advisory committee and administration involved in this process. The local shop owners are currently immersed in many of the changes we discussed and can provide valuable insight, to you and your administrators, into the needed changes. The rapidly changing market today makes this a very exciting time to be a part of the industry. Don't worry about your students; they are ready for these changes. Think about this… the smart phone is older than the students in your classroom today.

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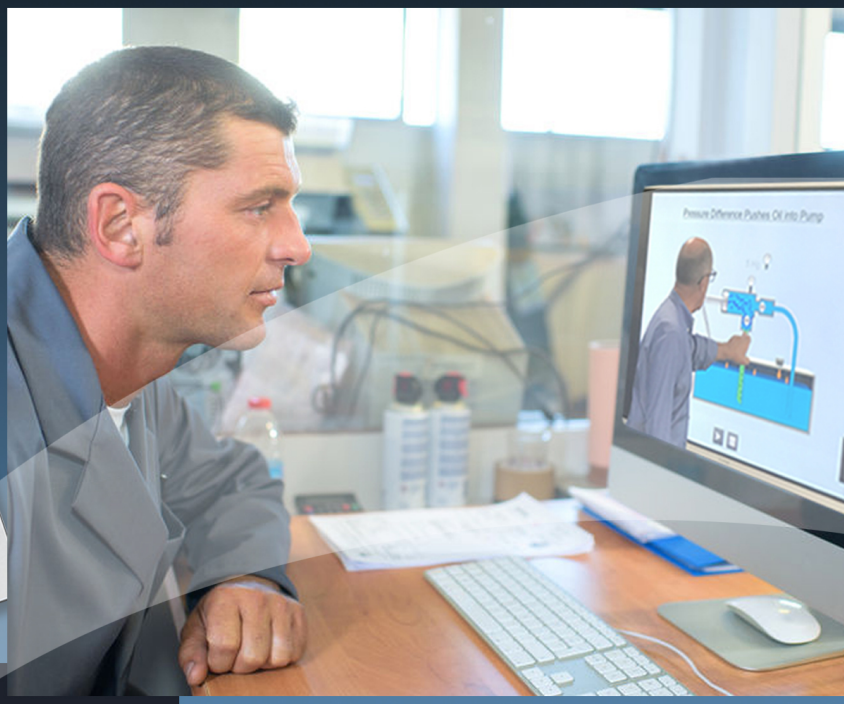

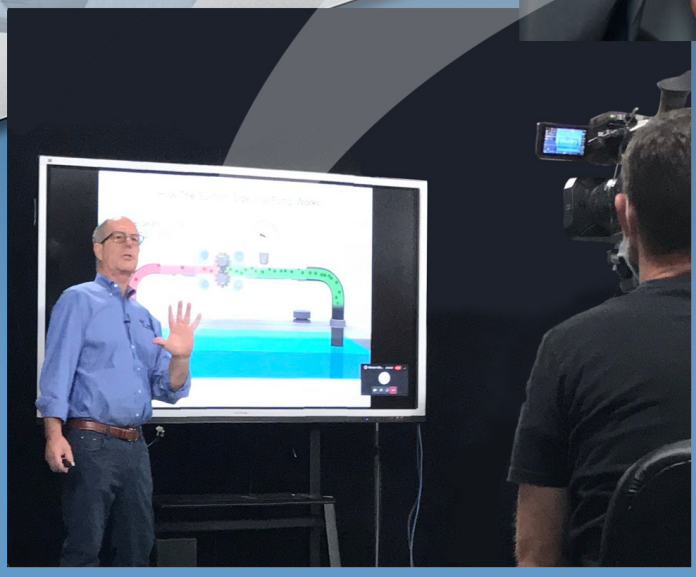

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Continued from Page 22

create a lot of troubles but e-learning will at least not keep us deprived of getting an education at our homes or workplaces.

Technology provides innovative and resilient solutions at times of crisis to combat disruption and helps people to communicate and even work virtually without the need of face-to-face interaction. This leads to many system changes in organizations as they adopt new technology for interacting and working (Mark & Semaan, 2008).

Weaknesses

E-learning has certain weaknesses in the form that it can hamper the communication between the learner and the educator, that is, direct communication and human touch are lost. Users can face many technical difficulties that hinder and slow-down the teaching–learning process (Favale et al., 2020). Time and location flexibility, though it is the strength of online learning these aspects are fragile and create problems. Student's nonserious behavior in terms of time and flexibility can cause a lot of problems. All students and learners are not the same, they vary in degrees of their capabilities and confidence level. Some do not feel comfortable while learning online, leading to increased frustration and confusion. Inadequate compatibility between the design of the technology and component of psychology required by the learning process; and inadequate customization of learning processes can obstruct the teaching process and creates an imbalance.

Opportunities

Online learning generally has a lot of opportunities available but this time of crisis will allow online learning to boom as most academic institutions have switched to this model. Online Learning, Remote Working, and e-collaborations exploded during the outbreak of Corona Virus crisis (Favale et al., 2020). Now, academic institutions can grab this opportunity by making their teachers teach and students learn via online methodology. The people have always been complacent and never tried some new modes of learning. This crisis will be a new phase for online learning and will allow people to look at the fruitful side of e-learning technologies. This is the time when there is a lot of scope in bringing out surprising innovations and digital developments. Already, EdTech companies are doing their bit by helping us fighting the pandemic and not letting learning to be put at a halt.

Teachers can practice technology and can design various flexible programs for students' better understanding. The usage of online learning will test both the educator and learners. It will enhance problem-solving skills, critical thinking abilities, and adaptability among the students. In this critical situation, users of any age can access the online tools and reap the benefits of time and location flexibility associated with online learning. Teachers can develop innovative pedagogical approaches in this panicky situation, now also termed as Panicgogy. EdTech Start-ups have plenty of opportunities to bring about radical transformations in nearly all the aspects associated with education ranging from, teaching, learning, evaluation, assessment, results, certification, degrees, and so on. Also, increasing market demand for e-learning is an amazing opportunity for EdTech start-ups to bring technological disruption in the education sector.

Challenges

Online learning faces many challenges ranging from learners' issues, educators' issues, and content issues. It is a challenge for institutions to engage students and make them participate in the teaching–learning process. It is a challenge for teachers to move from offline mode to online mode, changing

Continued on Page 32

VIRTUAL AAPEX EXPERIENCE WELCOMES STUDENTS

Students pursuing careers in the automotive aftermarket are invited to attend the Virtual AAPEX Experience where they'll have the opportunity to participate in under-the-hood training, learn about career paths and connect with potential employers. The Virtual AAPEX Experience is free to attend and will take place Tuesday, Nov. 3 through Thursday, Nov. 5, from 10 a.m. to 6 p.m., Eastern Standard Time (EST). Student registration is required and can be completed at: www.aapexshow.com/attendee-portal/register/student/.

By welcoming students, organizers of the virtual experience are providing additional training opportunities for young professionals pursuing industry career paths, helping them prepare for the future, while also highlighting opportunities in the automotive aftermarket to address the industry's need to attract top talent.

To best meet their education needs, students may select from beginner, intermediate and advanced-level technical and management training, as well as exhibitor-led training by DRiV/Garage Gurus, Autel, BOLT ON TECHNOLOGY, Bosch, Hunter Engineering, NAPA Auto Care and Kukui. For class descriptions, speaker information and dates/times, visit the Training Schedule at: https://www.aapexshow.com/schedule/.

Students also will be able to watch product and equipment demos in Joe's Garage, view innovative products in the New Product Showcase and schedule one-on-one meetings with exhibitors.

To attend, students must be enrolled in post-secondary automotive training programs or accredited colleges and universities.

The Virtual AAPEX Experience will serve as the hub of training, insights and connections for the more than $1 trillion global automotive aftermarket industry. It will feature instructor- and exhibitor-led training, product and equipment demos from industry suppliers, the New Product Showcase, and opportunities to connect one-on-one with exhibitors to talk products and conduct business.

AAPEX 2021 will return to the Sands Expo and Caesars Forum Conference Center in Las Vegas, Tuesday, Nov. 2 through Thursday, Nov. 4. All inquiries should be directed to W.T. Glasgow Inc., (708) 226-1300, billjr@aapexshow.com.

For additional information, visit the AAPEX 2020 FAQ page, https://www.aapexshow.com/faqs/.

Historically, AAPEX features approximately 2,500 exhibiting companies displaying their latest products, services and technologies that keep the world's 1.3 billion vehicles on the road.

AAPEX buyers include automotive service and repair professionals, auto parts retailers, independent warehouse distributors, program groups, service chains, automotive dealers, fleet buyers and engine builders.

AAPEX is a trade-only event and is closed to the general public.

AAPEX is co-owned by the Auto Care Association and the Automotive Aftermarket Suppliers Association (AASA), the light vehicle aftermarket division of the Motor & Equipment Manufacturers Association (MEMA). For more information, visit www.aapexshow.com or e-mail: info@aapexshow.com. On social media, follow AAPEX at #VirtualAAPEX.

Continued from Page 25

		(1) Sense of Belonging		(2) Academic and Social Concerns		(3) Academic Integration		(4) Academic Interest	
Gender									
	Full-sample estimates								
	EASE (Male)	0.243	(0.179)	0.280	(0.140)**	0.003	(0.201)	-0.011	(0.164)
	EASE*Female	-0.066	(0.200)	-0.258	(0.164)	0.435	(0.242)*	-0.043	(0.191)
	Subsample estimates								
	Male (N = 251)	0.243	(0.180)	0.280	(0.141)**	0.003	(0.202)	-0.011	(0.165)
	Female (N = 558)	0.177	(0.089)**	0.023	(0.085)	0.437	(0.134)***	-0.054	(0.097)
Race									
	Full-sample estimates								
	EASE (White)	0.145	(0.227)	0.262	(0.184)	0.436	(0.300)	0.043	(0.242)
	EASE*URM	-0.047	(0.259)	-0.243	(0.224)	-0.297	(0.363)	0.073	(0.279)
	EASE*Asian	0.171	(0.257)	-0.174	(0.214)	-0.004	(0.332)	-0.220	(0.270)
	Subsample estimates								
	White (N = 100)	0.145	(0.233)	0.262	(0.189)	0.436	(0.307)	0.043	(0.249)
	URM (N = 269)	0.098	(0.125)	0.019	(0.128)	0.139	(0.203)	0.115	(0.137)
	Asian (N = 440)	0.316	(0.120)***	0.088	(0.109)	0.431	(0.141)***	-0.178	(0.117)
First-generation status									
	Full-sample estimates								
	EASE	0.308	(0.133)**	-0.032	(0.111)	0.210	(0.160)	-0.005	(0.132)
	EASE*First-gen status	-0.222	(0.168)	0.223	(0.153)	0.202	(0.222)	-0.053	(0.172)
	Subsample estimates								
	Cont'ing-gen status (N = 410)	0.308	(0.133)**	-0.032	(0.111)	0.210	(0.160)	-0.005	(0.132)
	First-gen status (N = 399)	0.086	(0.103)	0.190	(0.105)*	0.412	(0.154)***	-0.059	(0.110)
Low-income (LI) status									
	Full-sample estimates								
	EASE	0.304	(0.116)***	-0.009	(0.101)	0.181	(0.147)	-0.088	(0.117)
	EASE*Low-income status	-0.276	(0.161)*	-0.435	(0.180)**	0.301	(0.222)	0.090	(0.168)
	Subsample estimates								
	LI status = 0 (N = 477)	0.304	(0.116)***	-0.009	(0.101)	0.181	(0.147)	-0.088	(0.117)
	LI status = 1 (N = 332)	0.028	(0.112)	0.203	(0.110)*	0.483	(0.167)***	0.002	(0.120)

Table 5. Robust standard errors in included in parentheses. All models include the following student controls: female, URM, Asian, first-generation status, low-income status, SAT Reading score, SAT Math score. The reference group is White. All items measured at the end of fall quarter and standardized to have a mean of 0 and a standard deviation of 1. All models include a pre-score. For Academic and Social Concerns, higher values indicate more concern. Missing values have been adjusted using a dummy variable approach.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$.

https://doi.org/10.1371/journal.pone.0213827.t005

Impact of EASE on the Desire to Remain in the Biological Sciences Major

The EASE program had little correlation with increases in major retention, as measured by the number of students still declared as majoring in Bio Sci by the end of their freshman year. This may be due, in part, to how uncommon it is for a student to be removed from a major in the freshman year, as it is a multi-step process involving a probationary period that may have prevented us from observing departure from the major within the ten-month time period of the study.

We also captured retention behavior using the following two survey questions: (1) "Are you thinking about changing your major?" and (2) "How likely are you to change majors within the next year?" These questions were presented to students at the end of the fall quarter as well as at the end of the spring quarter. Overall, 27% and 34% of students, respectively, reported that they were considering a major change.

Continued on Page 33

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Continued from Page 28

their teaching methodologies, and managing their time. It is challenging to develop content which not only covers the curriculum but also engage the students (Kebritchi et al., 2017). The quality of e-learning programs is a real challenge. There is no clear stipulation by the government in their educational policies about e-learning programs. There is a lack of standards for quality, quality control, development of e-resources, and e-content delivery. This problem needs to be tackled immediately so that everyone can enjoy the benefits of quality education via e-learning (Cojocariu et al., 2014). One should not merely focus on the pros attached to the adoption of online learning during the crises but should also take account of developing and enhancing the quality of virtual courses delivered in such emergencies (Affouneh et al., 2020). A lot of time and cost is involved in e-learning. It is not as easy as it seems, a considerable amount of investment is needed for getting the devices and equipment, maintaining the equipment, training the human resources, and developing the online content. Therefore, an effective and efficient educational system needs to be developed to impart education via online mode.

Ensuring digital equity is crucial in this tough time. Not all the teachers and students have access to all digital devices, internet, and Wi-Fi. Unavailability of proper digital tools, no internet connections, or iffy Wi-Fi connections can cause a lot of trouble due to which many students might lose out learning opportunities. Efforts should be taken by institutions to ensure that every student and faculty is having access to the required resources. They must also ensure that all the educational apps work on mobile phones as well, in case students do not have laptops. Therefore, steps must be taken to reduce the digital divide.

Practice makes a man perfect is a famous and very true proverb. Students and teachers across various universities have never really practiced e-learning. Most of them are complacent and are stuck with traditional modes of teaching. The Corona Virus outbreak is the chance to make out the best from the current situation. We can learn a lot in this challenging situation. A lot of tools are available, teachers are required to choose the best tool and implement it to impart education to their students. A step-by-step guide can be prepared by academic institutions that can guide the teachers and students on how to access and use various e-learning tools and how to cover major curriculum content via these technologies thereby reducing the digital illiteracy. Teachers can present the curriculum in various formats, that is, they can use videos, audios, and texts. It is beneficial if educators complement their lectures with video chats, virtual meetings, and so on to get immediate feedback and maintain a personal connection with the students.

Conclusions and Suggestions

Ayebi-Arthur (2017) conducted a case study of a college in New Zealand which was badly affected by seismic activities. In her study, she found that the college became more resilient to online learning after that disastrous event. Technology helped them overcome the barriers in those difficult times. But they suggest that robust IT Infrastructure is a prerequisite for online learning. Infrastructure needs to be so strong that it can provide unhindered services during and after the crisis.

As per the World Economic Forum, the Covid-19 pandemic also has changed the way how several people receive and impart education. To find new solutions for our problems, we might bring in some much-needed innovations and change. Teachers have become habitual to traditional methods of teaching in the form of face-to-face lectures, and therefore, they hesitate in accepting any change. But amidst this crisis, we have no other alternative left other than adapting to the dynamic situation and accepting the change. It will be beneficial for the education sector and could bring a lot o

Continued on Page 34

Continued from Page 30

We examine the Likert scale response to the second question in consideration of our demographic data and enrollment in the EASE program. As shown in **Table 6**, we find that students placed in the EASE program reported lower values for this item, indicating that they were less likely than non-EASE students to change their intended major. Specifically, EASE students reported values 0.21 standard deviation units lower than those reported by their non-EASE counterparts after the fall quarter and 0.12 standard deviation units lower than those reported by their non-EASE counterparts at the end of the year, the latter of which is not statistically significant.

			(1)		(2)	
			End of fall quarter		End of first year	
Panel A.						
EASE			-0.207**	(0.105)	-0.12	(0.102)
Panel B.						
Gender						
	Full-sample estimates					
		EASE (Male)	-0.365*	(0.192)	-0.219	(0.231)
		EASE*Female	0.241	(0.228)	0.037	(0.273)
	Subsample estimates					
		Male (N = 263)	-0.365*	(0.193)	-0.219	(0.233)
		Female (N = 571)	-0.124	(0.123)	-0.182	(0.146)
Race						
	Full-sample estimates					
		EASE (White)	0.286	(0.231)	-0.399	(0.333)
		EASE*URM	-0.758***	(0.289)	0.052	(0.392)
		EASE*Asian	-0.458*	(0.278)	0.280	(0.379)
	Subsample estimates					
		White (N = 101)	0.286	(0.237)	-0.399	(0.343)
		URM (N = 284)	-0.472***	(0.173)	-0.347*	(0.207)
		Asian (N = 449)	-0.172	(0.153)	-0.119	(0.179)
First-generation status						
	Full-sample estimates					
		EASE	-0.230	(0.167)	-0.228	(0.172)
		EASE*First-gen status	0.070	(0.218)	0.004	(0.255)
	Subsample estimates					
		Continuing-gen status (N = 424)	-0.230	(0.167)	-0.228	(0.172)
		First-gen status (N = 410)	-0.160	(0.141)	-0.225	(0.188)
Low-income status						
	Full-sample estimates					
		EASE	-0.349**	(0.141)	-0.093	(0.168)
		EASE*Low-income status	0.382*	(0.203)	-0.149	(0.251)
	Subsample estimates					
		Low-income status = 0 (N = 494)	-0.349**	(0.141)	-0.093	(0.168)
		Low-income status = 1 (N = 340)	0.033	(0.146)	-0.242	(0.187)

Table 6. Robust standard errors in included in parentheses. All models include the following student controls: female, URM, Asian, first-generation status, low-income status, SAT Reading score, SAT Math score. The reference group is White. All items are standardized to have a mean of 0 and a standard deviation of 1. Higher values indicate more likely to change majors. Missing values have been adjusted using a dummy variable approach.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$.

https://doi.org/10.1371/journal.pone.0213827.t006

When examining specific demographic groups, we find that the impact of EASE on intent to leave the major is greatest for male and URM students, both groups of which reported values 0.37 and 0.47 standard deviation units lower, respectively, than their non-EASE counterparts when assessments were conducted at the end of students' first term. It is important to note that the interaction term EASE*URM is negative and statistically significant. This indicates that EASE has the potential to reduce the White-URM student racial gap in regard to students' intent to change majors.

Continued on Page 35

Article: Online Learning

Continued from Page 32

surprising innovations. We cannot ignore and forget the students who do not have access to all online technology. These students are less affluent and belong to less tech-savvy families with financial resources restrictions; therefore, they may lose out when classes occur online. They may lose out because of the heavy costs associated with digital devices and internet data plans. This digital divide may widen the gaps of inequality.

This terrible time of fate has taught us that everything is unpredictable and we need to be ready to face challenges. Although this outbreak did not give us much time to plan we should take a lesson from this that planning is the key. We should plan everything, no matter if plan A fails, we should have plan B ready. This can only be done if we do scenario planning. There is a need to prioritize all the critical and challenging situations which may occur and plan accordingly. This pandemic has also taught us that students must possess certain skills such as skills of problem solving, critical thinking, and most importantly adaptability to survive the crisis. Educational institutions must build resilience in their systems to ensure and prioritize the presence of these skills in their students.

“The key lesson for others may be to embrace e-learning technology before disaster strikes!” (Todorova & Bjorn-Andersen, 2011). Today, we are forced to practice online learning, things would have been different if we have already mastered it. The time we lost in learning the modes could have been spent on creating more content. But it is better late than never. This virus surely has accelerated the process of online learning. For instance, this e-application called ZOOM is making a lot of news because of its viable features. It allows conducting live online classes, web-conferencing, webinars, video chats, and live meetings. As most of the schools, colleges, universities, companies are closed due to lockdowns/curfews and most of the people are working from home, this app helped in keeping people connected via video conferencing. This application is trending on Google play store amidst the ongoing crisis. People are practicing social distancing so this application gave them a sigh of relief. ZOOM also allows conducting business meetings.

Continued on Page 39

Continued from Page 33

Limitations

The present study is not without limitations. Most notable among them is that the research design used is correlational, and we therefore cannot rule out the possibility that our results are subject to omitted variable bias. Given that participation in EASE is correlated with a number of demographic variables—EASE participants are more likely to earn lower standardized test scores, for example—we can assume that there are unobservable factors that are correlated with EASE participation and our outcome measures. For example, given that EASE participants are intentionally made aware of campus resources, they could very well be more likely to use them. One could imagine a scenario where EASE participants interact with the campus' peer tutors more often than non-EASE participants. If true, the treatment effects reported in this study regarding course grades and GPA would be over-estimated.

In another example, given the limited number of variables available in the dataset, we may not have fully captured student ability and pre-college resources, both of which are correlated with a number of our outcome measures. This is particularly important since the characteristics associated with EASE participants indicate that they are more likely to come from lower quality high schools and from family backgrounds with less financial resources. Adding additional control variables, such as high school location and a refined measure of socio-economic status could provide a more precise, unbiased point estimate. It is important to note, however, that without these variables our point estimates are actually under-estimated.

Additionally, our findings associated with academic integration must be interpreted somewhat cautiously, as Cronbach's alpha was only 0.60. This could indicate that the individual items in the scale have residual variance accounted for by different variables, other than academic integration. However, a student's reported frequencies for "talking with faculty about academic matters," "meeting with an academic advisor," "meeting with a student mentor," and "attending study groups outside of the classroom" could also be quite different from one another because students who frequently engage in at least one of these forms of academic help-seeking may not feel the need to engage in all of them. Although this would create low reliability for the scale, a higher average overall would still represent a greater amount of academic integration.

Discussion

Our study has focused on a STEM learning community program, EASE, evaluating its impact on student cognitive and social-psychological outcomes. We have sought to investigate who benefits from learning community programs in order to better understand whether learning communities are a viable way to reduce both academic and motivation gaps often present in STEM disciplines. Overall, participation in the EASE program positively impacted both cognitive and social-psychological outcome measures. EASE designation is correlated with higher grades in Bio Sci 94, a key freshman level biology course, as well as with a nearly quarter-point boost in first-year cumulative GPA. Additionally, EASE students indicated that they experienced an improved sense of belonging and academic integration in addition to indicating that they were less likely to consider a change in major after participating in the program.

In examining the impact of the EASE learning community program on different groups of students, we find that students traditionally underrepresented in STEM exhibited the greatest gains regarding the study's social-psychological measures. For example, females participating in EASE reported higher values for the sense of belonging measure than did non-EASE females. Further, female

Continued on Page 36

Continued from Page 35

students, first-generation students, and students from low-income backgrounds all reported higher rates of engagement in behaviors indicative of academic integration relative to their non-EASE peers.

Surprisingly, however, the gains in social-psychological metrics do not correspond to disproportionate increases in academic outcomes for these same student populations. Although EASE status is associated with higher Bio Sci 94 course grades and first-year GPA, these effects tend to be greater for EASE students from more traditionally-represented demographics (males, White students, continuing-generation individuals, and non-low-income students). These results suggest that EASE does not reduce gender or racial achievement gaps in first-year biology courses. While much of the STEM education literature is focused on closing achievement gaps, we argue that the observed gains for the entire EASE population highlights the clear value of learning communities programs. The finding that EASE enrollment correlates with a nearly quarter point increase in first-year GPA relative to non-EASE participants means that an entire group of students may have increasing opportunities in STEM programs and careers. This may also imply however that many of the barriers to success for students underrepresented in STEM fields are also present in the EASE program. For example, while attempts were made to recruit underrepresented students to act as EASE mentors, they ultimately were predominately of Asian and White ethnicities. Thus, EASE students from underrepresented backgrounds may have had trouble connecting with their mentors or viewing them as representations of their own success. This would be similar to the impact of the lack of diversity in STEM faculty [53–54].

It is important to note that the discussed findings for cognitive and social-psychological measures point to the complex relationship between academic and social integration, as outlined in **Fig 1.** Academic and social integration are mutually reinforcing elements, and while we do not find evidence that these forces are operating concurrently—as evidenced by, for example, the idea that URM students experience disproportionate gains for a number of social-psychological measures but not for performance markers—prior research has found that treatment effects unfold over time [33,55]. As such, the social-psychological benefits experienced by students traditionally underrepresented in STEM may translate to positive long-run academic performance outcomes, such as strong grades earned in the second year of college or even major persistence. The consistent positive coefficients for the academic measures, although statistically insignificant, substantiate this conjecture. Our findings also suggest that examining long-run impacts will be important for fully understanding the ways in which learning communities improve student learning outcomes and the college experience as a whole.

We also find that the results concerning subgroup populations (**Tables 3 and 5**)—and for first-generation college students in particular—do not necessarily support Culture Mismatch Theory. As we note, first-generation students in EASE earned higher grades than their non-EASE counterparts (**Table 3, column 2**). These treatment effects, however, were not significantly different than continuing-generation students. In other words, EASE did not have a significant impact on reducing the socio-economic achievement gap.

First-generation college students also reported values for one of our outcome variables, academic and social concerns, in the opposite direction of what was expected. For this particular outcome, first-generation college students in EASE reported higher values, indicating that they were relatively more concerned that other students disliked them or unfairly evaluated their academic ability, as compared to non-EASE first-generation college students. One possible explanation could be the idea that academic preparation programs, such as EASE, might enhance feelings of stigmatization

Continued on Page 38

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Voting will take place in July 2021.

Continued from Page 36

often felt among groups traditionally marginalized in college. Indeed, a separate study on EASE students found that both continuing- and first-generation students assigned to EASE felt somewhat stigmatized when learning of their assignment to the EASE program [56]. Initial feelings of stigmatization, in turn, were predictive of greater academic and social concerns during the school year. We do want to note that the point estimate for the variable academic and social concerns in our study is significant at the $p < .10$ level and the standard error is quite big; compared to other associations that we discuss in our paper, this one is relatively weak.

Lastly, even though the EASE program had no statistical impact on retention, we do find that it is positively correlated with students' intention to stay in the bio sci major, which is particularly important given that this measure is an early indicator of engagement. Further, among the three race-oriented groups, this impact is most pronounced for URM students. URM students who participated in EASE reported values 0.47 standard deviation units lower than those reported by non-EASE URM students. This finding is particularly important given the national agenda to improve STEM outcomes for students least represented in STEM. A learning community certainly seems to have the potential to help URM students, in particular, progress through the STEM pipeline.

Our results also suggest that there might be a connection between the cognitive effects of participating in EASE and students' intent to remain in the major, as outlined in **Fig 1**. For example, male students in EASE reported significantly lower values for the item measuring intent to leave the major than did non-EASE male students, whereas the difference for female students is not significant. The disproportionate impact for male students might be attributed to the large and significant impact that EASE had on male students' academic performance. It may be the case that doing well academically makes students feel more confident about their future in the biological sciences.

Overall, our findings echo conclusions found in prior literature: learning communities benefit students both academically and social-psychologically. We add to this body of work by documenting the potential for learning communities to impact student learning and engagement within a specific field of study. Further, our focus on estimating impacts for particular student subgroups has resulted in evidence indicating that students respond to learning communities differently. Ideally, this evidence can help researchers and practitioners design programs tailored to meet different needs, thereby enhancing the ability of learning communities to positively impact the overall college experience.

Supporting Information

Items used for the social-psychological constructs evaluated by the survey instruments, the complete beginning of fall survey, and the complete end of fall and spring quarter surveys are presented in the supporting information and can be downloaded from: https://doi.org/10.1371/journal.pone.0213827.s001

Acknowledgements

We would like to thank Dr. Michael Leon, Kristin Fung, and Jenna Bague-Sampson for their support during this research project, as they have provided data and expert guidance on the context for this research.

References

References may be viewed by clicking:
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0213827#sec006

Continued from Page 34

Disasters will continue to occur and technologies will likely help us cope with them (Meyer & Wilson, 2011). Don Dippo, The Co-Principal Investigator at the Borderless Higher education for Refugees said that "We are in a world where conflict and environmental destruction … are going to have lots of people, families, and communities, living in precarious contexts. The willingness of post-secondary institutions to step-up and engage and provide opportunities for those people will never be as large as the need. The only way we can even make a dent in this is to learn to collaborate and cooperate across institutions and across time and spatial boundaries. The only way really to do that is to rely on technology to create conditions to allow people to collaborate."

We need a high level of preparedness so that we can quickly adapt to the changes in the environment and can adjust ourselves to different delivery modes, for instance, remote learning or online learning in situations of pandemics such as Covid-19. Institutions and organizations should prepare contingency plans to deal with challenges such as pandemics and natural disasters (Seville et al., 2012). Reliability and sufficient availability of Information Communication Technology infrastructure, learning tools, digital learning resources in the form of Massive Open Online Courses, e-books, e-notes, and so on are of utmost importance in such severe situations (Huang et al., 2020). Instruction, content, motivation, relationships, and mental health are the five important things that an educator must keep in mind while imparting online education (Martin, 2020). Some teaching strategies (lectures, case-study, debates, discussions, experiential learning, brainstorming sessions, games, drills, etc.) can be used online to facilitate effective and efficient teaching and learning practices. In such panicky situations, where the lives of so many people are at stake, teaching and learning should be made interesting. This will also reduce the stress, fear, and anxiety levels of people. For this, proper technique and learning support should be provided to teachers and students and government support is also crucial at such stage. Pedagogical and technical competency of online educators is of utmost importance. Rigorous quality management programs and continuous improvement are pivotal for online learning success and making people ready for any crisis-like situation.

Natural disasters can stimulate our motivation for the adoption of highly innovative communication technology and e-learning tools (Tull et al., 2017). To make e-learning effective in such difficult times, we need to focus on the use of technology more efficiently, that is, the usage of that technology which has minimum procurement and maintenance costs but can effectively facilitate educational processes. Before bringing in and adopting any e-learning tool or technology, its pros and cons need to be weighed. Institutions should conduct plenty of research when bringing the right technology for different educational initiatives. There should be proper clarity on the purpose and context of technology adoption. As several factors affect the choice of a particular technology such as security features, availability and condition of laboratories, internet speed, internet access, digital literacy levels of the beneficiaries, and so on. E-learning can help in providing inclusive education even at the time of crisis. Such systems need to be developed in educational institutions that make sure that no student is getting deprived of education due to their location, social class, ethnicity, and so on. Online methods of teaching support and facilitate learning–teaching activities, but there is a dire need to weigh the pros and cons of technology and harness its potentials. Disasters and pandemic such as Covid-19 can create a lot of chaos and tensions; therefore, there is an important need to study the technology deeply and with due diligence to balance these fears and tensions amidst such crisis.

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