Learning From a Pandemic: Redesigning with Universal Design for Learning to Enhance Scientific Skills (Practice Brief)

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Abstract

Colleges are becoming increasingly diverse, including strengthening representation of students with disabilities in STEM (Science, Teaching, Engineering, and Math) fields; however, representation still lags behind national trends. To adapt to this changing demographic and improve representation, STEM college professors must be prepared to grant equitable access to the STEM curriculum and enhance scientific communication skills. This practice brief outlines how a college science faculty applied the Universal Design for Learning (UDL) framework to improve scientific communication skills equitably among college students with diverse needs during a 10-week NSF-REU (National Science Foundation – Research Experiences for Undergraduates) at the host institution summerxperansrIduring ahe hCOVID-19 padermic. It also

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attention deficit hyperactivity disorder [ADHD]. Participants of the NSF-REU program are matched with two mentors, one from the host University and another from the student's home institution. Typically, students live on campus while working on their research projects; however, campus living was not an option during COVID-19. The host University received IRB approval to collect data from individuals attending the summer program.

As previously stated, the COVID-19 pandemic was highly disruptive and required significant programmatic restructuring to adapt to an online-only paradigm. Beyond the technical and logistical aspects, the pandemic exacerbated the mental health needs of students, who required additional support (Barbieri et al., 2021). However, the move to online instruction created an unanticipated opportunity to redesign the program to be intentionally grounded in UDL. The virtual environment allowed students to participate from individual spaces, while video recording permitted both repeat watching and asynchronous learning, all aspects that supported UDL. Overall, the faculty noted that both those who did and did not self-report disability were able to succeed in a STEM research program during the pandemic.

Working closely with their mentors, the participants chose a scientific problem and designed a hypothesis to examine their proposed project. The program cumulates with all students presenting the products of their research at regional and/or national conferences. More specifically, to enhance student development, students attended classes, labs, and workshops ranging from 45-90 minutes to discuss current issues in STEM (e.g., ethics, electronic lab tools, how to search databases effectively). These educational opportunities allow students to explore needs in their field of interest and future career goals along with developing communication skills through scaffolded exercises (Montgomery et al., 2022). To date, over 95% of the students who participated in the summer 10-week program subsequently enrolled in a graduate program (i.e., Ph.D., medical, or dental school).

Each guideline of UDL was addressed during the program. Use of intentional scaffolding along with a mixture of presentation, recordings, one-to-one meetings, and student directed learning supported students to engage with the material through their own optimal representation. Finally, by building in biweekly oral presentations and written assignments, along with individual discussions with mentors, and a final conference presentation, the students received many different ways to express what they had learned and demonstrate mastery.

Evaluation of Observed Outcomes

Surveys and performance outcomes were used to evaluate the effectiveness of the program. Data on student self-perception was collected at the start and end of the program for the purposes of institutional reporting and tracking student progress. The researchers used an informal Likert survey to understand students' self-perception of their gain in scientific skills across the program. Statistically significant changes from pre- to post-course indicate that individuals who attended the program reported meaningful impact towards their progress in STEM fields (See Table 1).

We observed strong positive gains in students' confidence in drawing data-based conclusions using the scientific method from the start to the end of the program (Montgomery et al., 2022). Qualitative data informed participants' confidence with this program. Participants reported that revisiting recorded lectures minimized feeling overwhelmed by new material. They also discussed appreciation of the program embedding mental health days for students to take care of non-academic needs. Finally, individuals in the program stated the benefit of asynchronous STEM topics tied to real world problems allowing them to see how issues were solved. We saw improvements in students' perceptions of their ability to conceptualize and present scientific data in both written and oral formats. Beyond the survey data, a clear qualitative indication of this growth was how the students' weekly presentations changed as assessed by the faculty, with each student gaining confidence and competence. This was aided through aspects of UDL, such as recorded background lectures that allowed students to rewatch prior material as needed to build mastery. Moreover, having students participate in group discussions and presentations through Zoom permitted students with anxiety to engage in early weeks with video off. By the end of the summer all students reported being comfortable presenting live with full video. This cumulated with the students presenting at a local conference, and several also presenting at national conferences (e.g., American Chemical Society Spring Conference).

Implications and Transferability

While COVID-19 generally hindered education, this online summer program offered many benefits to participants that helped them adapt and academically thrive. Indeed, during the program students experienced many difficulties. For example, students lacked access to the internet, acquired disabilities from COVID-19 (e.g., long-haul COVID, anxiety),

or experienced new responsibilities (e.g., caring for a younger sibling). Knowing the struggles students experienced due to the pandemic, the faculty redesigned the summer program using the UDL framework to offer multiple learning opportunities to demonstrate mastery.

The REU program provided pathways for students to request support from their close mentors and faculty, along with accessing meaningful accommodations that can be applied to all programs across the university. For example, faculty scaffolded and recorded all lectures so that students could review past lessons and prepare for classes and presentations, and assigned designated mental-health days so that students would be able to request meetings, catch up on content missed or not mastered, attend hospital appointments, or take a break. Finally, faculty required one-to-one and group meetings with students focused on STEM careers of interest to align practicing and applying the scientific problems each week. These meetings allowed students to see the scientific method applied in future job opportunities. Minor changes made to support students for the online program and classroom development (e.g., recorded lectures, group problem-solving meetings) can have significant impact for students with disabilities majoring in STEM as all participants with disabilities who attended the online redesign either pursued a career or graduate degree in a STEM field. With these simple changes, STEM faculty can easily adopt and implement UDL to create more inclusive learning opportunities.

Limitations

While the dissemination of the program has strengths, limitations were identified. Some participants did not have internet access, which impacted online learning. To address this initial limitation, wireless hotspots and necessary technology (i.e., computers and required software) were provided for participants as needed. Unreliable access to internet reinforced the importance of allowing participants to access materials through both asynchronous and synchronous pathways. A second limitation was that not all students disclosed their disabilities with disability support services at the University; they only confided with faculty mentors. Faculty may not have had background knowledge to support students' accommodations adequately beyond what was requested or implemented through UDL. Future program replication must consider participants' access to the inter-

certainty that those students with disabilities improved to a similar degree. Furthermore, this population includes highly driven students who applied to work in a science summer program, which shows a high level of motivation and dedication, and indicates that this approach has good transferability for similar summer programs. Finally, the quantitative data we collected used a self-reporting Likert scale. However, even with these limitations the results obtained suggest that this program was effective at incorporating

References

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