Perspective

JMBE Journal of Microbiology & Biology Education

We Can't Fail Again: Arguments for Professional Development in the Wake of COVID-19

Lisa L. Walsh,[a] Robert J. Bills,[b] Stanley M. Lo,[c] Emily M. Walter,[d] Benjamin E. Weintraub,[b] and Michelle D. Withers[b]

[a]*Donald Danforth Plant Science Center, St. Louis, Missouri, USA*
[b]*Binghamton University, Binghamton, New York, USA*
[c]*University of California San Diego, La Jolla, California, USA*
[d]*California State University - Fresno, Fresno, California, USA*

The majority of academic institutions were underprepared for a global pandemic, leading to spikes in instructor anxiety and drops in student engagement with STEM courses. With many STEM professors teaching online for the first time, they independently sought out training in distance education and inclusive teaching practices. Had institutions been proactive in providing such professional development prior to the pandemic, the negative impacts of transitioning to online education would have been reduced. While recent events are still fresh in people's minds, we advocate for increased or maintained professional development opportunities for STEM instructors in order to protect this critical pedagogical support from budget cuts.

KEYWORDS emergency education, faculty, instructor, professional development, support

PERSPECTIVE

SARS, H1N1, Hurricane Katrina, Syrian War, and beyond—the list of epidemics, natural disasters, and socio-political unrest that interrupted Academia before 2020 is long, yet higher education did little to disseminate the lessons learned from these events. As news of a novel coronavirus spread in early 2020, institutions of higher education (IHEs) failed to anticipate its severity and allocate the resources necessary to prepare faculty for an emergency interruption to education. Thus, when COVID-19 was declared a pandemic and IHEs closed their campuses and rapidly moved classes online, many science, technology, engineering, and math (STEM) faculty faced the challenge of teaching online for the first time with no prior training and little institutional guidance (1–4).

The COVID-19 pandemic challenged STEM faculty more than ever to juggle their students' needs with their own personal and professional responsibilities. Preexisting inequities among students were spotlighted and deepened by the events of 2020, prompting some STEM instructors to seek training in online education and inclusive teaching practices (5). As Academia proceeds into an uncertain future and looming budget cuts, we advocate for the promotion of professional development (PD) that effectively prepares faculty to implement evidence-based, inclusive, and modality-flexible instructional practices.

PREVIOUS SCHOLARLY ATTEMPTS

Academic positions require both discipline-specific expertise and the ability to help others achieve mastery, however graduate training typically only prepares future faculty for half of that job. Handelsman likened U.S. science graduate programs that emphasize research training but ignore pedagogical instruction to a one-handed piano school where students are taught to play with their right hand assuming the left will figure it out later (6). While formal pedagogical training for future STEM faculty is on the rise, it is not the norm, resulting in practitioners teaching with traditional, passive approaches that are less effective for student success, especially those from historically excluded groups (7, 8). Two meta-studies of the literature on the impact of teaching strategies in post-secondary STEM education highlight the supremacy of active learning in improving performance and success (9) and closing performance gaps for underserved populations (8).

Instructor access to PD is highly ephemeral but is critical for fostering STEM education reform (10) and increasing participant use of evidence-based strategies that enhance student persistence and learning (11). STEM faculty often turn to their institution's Teaching and Learning Center or to national programs

Address correspondence to Donald Danforth Plant Science Center, St. Louis, Missouri, USA. E-mail: lwalsh@danforthcenter.org.
The authors declare no conflict of interest.
Received: 1 December 2021, Accepted: 11 February 2022, Published: 4 April 2022

for resources that support implementation of effective educational practices (1, 12). By investing in PD, IHEs retain satisfied faculty and produce positive pedagogical outcomes that serve as persuasive advertisements to prospective students. Collaborative faculty groups dedicated to the scholarship of teaching and learning (SoTL) provide instructors with structured time to dedicate to investigating personalized classroom issues, which may improve recruitment efforts for institutional PD. SoTL is an inquiry-based professional development activity that effectively fosters self-reflection and refined pedagogy in instructors (13).

When IHEs shifted the majority of courses into a remote setting, this underlined the importance of accessible, IHE-provided PD as many STEM faculty had to use new instructional strategies and technology. The sudden transition to emergency remote teaching proved a challenge to STEM instructors who had been teaching hands-on, in-person laboratory classes. Instructors, regardless of experience, had to become efficient users of their institution's online learning management systems (e.g., Canvas, Moodle) and create lectures and activities that were pedagogically sound and accessible to students both synchronously and asynchronously (14). Instructors with pedagogical training reported higher levels of comfort in remote venues compared to respondents who did not participate in pedagogical training (1). The pandemic also revealed that many faculty needed training in how to comply with the Americans with Disabilities Act (15) and how to support students who are underrepresented in STEM (16). As faculty also struggled with losing in-person interactions with students, effective PD would have helped them foster student engagement and positive psychology in their teaching (15).

CURRENT WORKS ADDRESSING THE PROBLEM

Effective PD considers both professional and personal needs and authentically addresses essential pedagogy, leading to increased student-centered learning and course novelty (17). PD is especially well-received when it is embedded in teaching itself, provides new instructional strategies, and forms collaborative learning communities of instructors (18). There are examples of such effective PD even during the pandemic. Chemistry faculty at a private liberal arts college and their students developed a plan in 5 days to transition department classes online (19). Faculty from across the country who participated in the Community College Anatomy and Physiology Research (CAPER) project and professional development prior to and during the pandemic used their new skills that were more compassionate to the challenges students faced and integrated active learning strategies to their emergency remote teaching (20). In a PD course for chemistry graduate TAs at a private R1 university, the instructor highlighted wellness and community-building skills in addition to pedagogical and technical skills (21).

In a comparative study that examined introductory biology course student outcomes at a public R1 university, course grades were higher during the first COVID quarter compared to its preceding pre-COVID quarter, and course grades were reduced between racially minoritized students and their peers during the COVID quarter. These results suggest that professors intuitively adjusted course grading in response to the new, pandemic-driven remote environment. In assessing student learning experiences within the same courses, researchers found students had reduced social support in the classroom, indicating that the professors lacked training in how to cultivate a sense of community and environment of trust in their remote classroom (22). A survey deployed to undergraduate STEM students at 23 U.S. institutions both at the onset of the pandemic and conclusion of the first COVID-impacted semester revealed that student engagement declined (23). STEM faculty from a variety of institutions who never received training in online education encountered more challenges with student engagement and their own morale (4). Based on emerging research that surveyed over 200 faculty nationwide (24), student-centered learning was only maintained in the first semester of the pandemic when instructors had both robust technical pedagogical knowledge and the belief that learning happens through constructivist methods (not through transmission). Thus, PD resilient to disruptions would include technical, pedagogical, and attitudinal training to help instructors weather the crisis.

LOOKING FORWARD

Faculty represent important long-term institutional investments. While the COVID-19 pandemic may present acute financial challenges to IHEs, a preliminary response should not be to reduce funding for faculty PD. A commitment to improve STEM education, especially with a view toward the post-pandemic world, signals to future students and their families that faculty at an institution are equipped to provide effective, inclusive instructional practices for both in-person and remote learning environments. There are mechanisms to continue support for faculty PD at IHEs with limited resources. For example, PD on educational quality and equity can be built into new faculty orientations, which are often more focused on logistics and administrative issues (25). To foster long-term sustainability, promotion and tenure applications can require evidence for PD activities and documentation of evidence-based inclusive instructional practices.

There are societies that provide free PD to faculty from under-resourced institutions (e.g., https://palm.ascb.org/). Another mechanism to support faculty PD with limited resources is to ensure accountability and leverage existing funds for sustainability. For example, the University of California Irvine (UCI) recently launched an Education Research Initiative (ERI) with a mini-grant program to support research and implementation of innovations in undergraduate education, where funds are released in three stages: when the mini-grants are funded, when a manuscript is submitted to a peer-reviewed journal, and when an external grant proposal is submitted. To ensure sustainability of the ERI, all external proposals submitted as part of the mini-grants have to budget for funds to support part of a postdoctoral scholar position that

collaborates on the grant activities. While the UCI ERI represents substantial new investments, IHEs with existing funding mechanisms for faculty PD can add similar elements to foster accountability and sustainability, regardless of the budget of the program and the size of the awards.

CONCLUSION

The landscape of higher education shifted abruptly due to the COVID-19 pandemic and will likely remain altered. The rapid transition online and inequities among students made access to PD even more valuable to improve online instruction, inclusive student learning, and equity in teaching (26–31). To become resilient in a post-pandemic world, STEM Academia must address the PD needs of faculty and instructors. PD in higher education can have multiple areas of emphasis (32), however, a dual focus on the use of active learning (8) and development of inclusive, equitable classes (33) across modalities, may best address our current needs. Here, we provide arguments for faculty to ask for cost-efficient, effective, and holistic PD as higher education begins to explore what post-pandemic Academia looks like.

ACKNOWLEDGMENTS

We thank Kristine Callis-Duehl for helping to create our network of researchers.

None of the authors have a financial, personal, or professional conflict of interest related to this work.

REFERENCES

1. Bills RJ, Weintraub B, Withers MW. 2021. Factors that impact comfort and use of active learning strategies, particularly during the pandemic-induced shift to remote learning. Abstr 65th Annual Meeting. Association of College and University Biology Educators. http://www.acube.org/wp-content/uploads/2021/10/ACUBE-2021-Program.pdf.
2. Brewe E, Traxler A, Scanlin S. 2021. Transitioning to online instruction: strong ties and anxiety. Physical Rev Phys Educ Res 17:e023103. https://doi.org/10.1103/PhysRevPhysEducRes.17.023103.
3. Rutherford T, Karamarkovich SM, Xu D, Tate TP, Sato B, Baker RB, Warschauer M. 2021. Profiles of instructor responses to emergency distance learning. Online Learn 25:86–114.
4. Walsh LL, Arango-Caro S, Wester ER, Callis-Duehl K. 2021. Training faculty as an institutional response to COVID-19 emergency remote teaching supported by data. CBE Life Sci Educ 20:ar34. https://doi.org/10.1187/cbe.20-12-0277.
5. US Department of Education Office for Civil Rights. 2021. Education in a pandemic: the disparate impacts of COVID-19 on America's students. U.S. Department of Education Office for Civil Rights. https://www2.ed.gov/about/offices/list/ocr/docs/20210608-impacts-of-covid19.pdf.
6. Handelsman J. 2003. Teaching scientists to teach. HHMI Bull 16:31.
7. Stains M, Harshman J, Barker MK, Chasteen SV, Cole R, DeChenne-Peters SE, Eagan MK, Jr, Esson JM, Knight JK, Laski FA, Levis-Fitzgerald M, Lee CJ, Lo SM, McDonnell LM, McKay TA, Michelotti N, Musgrove A, Palmer MS, Plank KM, Rodela TM, Sanders ER, Schimpf NG, Schulte PM, Smith MK, Stetzer M, Van Valkenburgh B, Vinson E, Weir LK, Wendel PJ, Wheeler LB, Young AM. 2018. Anatomy of STEM teaching in North American universities. Science 359:1468–1470. https://doi.org/10.1126/science.aap8892.
8. Theobald EJ, Hill MJ, Tran E, Agrawal S, Arroyo EN, Behling S, Chambwe N, Cintrón DL, Cooper JD, Dunster G, Grummer JA, Hennessey K, Hsiao J, Iranon N, Jones L, Jordt H, Keller M, Lacey ME, Littlefield CE, Lowe A, Newman S, Okolo V, Olroyd S, Peecook BR, Pickett SB, Slager DL, Caviedes-Solis IW, Stanchak KE, Sundaravardan V, Valdebenito C, Williams CR, Zinsli K, Freeman S. 2020. Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math. Proc Natl Acad Sci U S A 117:6476–6483. https://doi.org/10.1073/pnas.1916903117.
9. Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, Wenderoth MP. 2014. Active learning boosts performance in STEM courses. Proc Natl Acad Sci U S A 111:8410–8415. https://doi.org/10.1073/pnas.1319030111.
10. Laursen S. 2019. Levers for change: an assessment of progress on changing STEM instruction. American Association for the Advancement of Science. www.aaas.org/resources/levers-change-assessment-progress-changing-stem-instruction.
11. Durham MF, Aragón OR, Bathgate ME, Bobrownicki A, Cavanagh AJ, Chen X, Trochim WM, Waterhouse JK, Graham MJ, Couch BA. 2020. Benefits of a college STEM faculty development initiative: instructors report increased and sustained implementation of research-based instructional strategies. J Microbiol Biol Educ 21:21.2.55. https://doi.org/10.1128/jmbe.v21i2.2127.
12. Manduca CA, Iverson ER, Luxenberg M, Macdonald RH, McConnell DA, Mogk DW, Tewksbury BJ. 2017. Improving undergraduate STEM education: the efficacy of discipline-based professional development. Sci Adv 3:e1600193. https://doi.org/10.1126/sciadv.1600193.
13. Burns KA. 2017. Community college faculty as pedagogical innovators: how the Scholarship of Teaching and Learning (SoTL) stimulates innovation in the classroom. Commun College J Res Practice 41:153–167. https://doi.org/10.1080/10668926.2016.1168327.
14. Jankowski NA. 2020. Assessment during a crisis: responding to a global pandemic. Urbana, IL: University of Illinois and Indiana University, National Institute for Learning Outcomes Assessment.
15. Kennette LN, Myatt B. 2018. How the post-secondary classroom can benefit from positive psychology principles. Psych Teaching Rev 24:63–66.
16. Harper SR. 2020. COVID-19 and racial equity implications of reopening college and university campuses. American J Educ 127:153–162. https://doi.org/10.1086/711095.
17. Arbaugh F, Marra R, Lannin JK, Cheng Y, Merle-Johnson D, Smith R. 2016. Supporting university content specialists in providing effective professional development: the educative role of evaluation. Teacher Development 20:538–556. https://doi.org/10.1080/13664530.2016.1173577.

18. Hunzicker J. 2011. Effective professional development for teachers: a checklist. Prof Development Educ 37:177–179. https://doi.org/10.1080/19415257.2010.523955.
19. Anstey MR, Blauch DN, Carroll FA, Gorensek-Benitez AH, Hauser CD, Key HM, Myers JK, Stevens EP, Striplin DR, Holck HW, Montero-Lopez L, Snyder NL. 2020. #DavidsonTrue: transitioning to remote teaching while maintaining our values as a liberal arts college during the COVID-19 pandemic. J Chem Educ 97:2800–2805. https://doi.org/10.1021/acs.jchemed.0c00782.
20. Deutschman MC, Hyson AR, Seithers LC, Jensen M. 2021. Teaching interrupted: how COVID-19 turned thoughts into practice. J Microbiol Biol Educ 22:22163. https://doi.org/10.1128/jmbe.v22i1.2613.
21. Dragisich V. 2020. Wellness and community modules in a graduate teaching assistant training course in the time of pandemic. J Chem Educ 97:3341–3345. https://doi.org/10.1021/acs.jchemed.0c00652.
22. Zuckerman AL, Hardesty RA, Denaro K, Lo SM, Owens MT. 2021. Effects of remote teaching in a crisis on equity gaps and the constructivist learning environment in an introductory biology course series. J Microbiol Biol Educ 22:ev22i1-2293.
23. Wester ER, Walsh LL, Arango-Caro S, Callus-Duehl KL. 2021. Student engagement declines in STEM undergraduates during COVID-19–driven remote learning. J Microbiol Biol Educ 22:22150. https://doi.org/10.1128/jmbe.v22i1.2385.
24. Walter EM, Bailey ML, Fernandez P, Gill A. In review. An exploration of postsecondary teaching, technology, and mental well-being during COVID-19. CBE Life Sci Educ.
25. Marbach-Ad G, Ziemer KLS, Thompson KV, Orgler M. 2013. New instructor teaching experience in a research-intensive university: implications for professional development. J Centers Teach Learn 5:49–90.
26. Roman T, Kelsey K, Lin H. 2010. Enhancing online education through instructor skill development in higher education. OJDLA 13:1–9.
27. Aragón OR, Dovidio JF, Graham MJ. 2017. Colorblind and multicultural ideologies are associated with faculty adoption of inclusive teaching practices. J Divers High Educ 10:201–215. https://doi.org/10.1037/dhe0000026.
28. Dewsbury BM. 2017. On faculty development of STEM inclusive teaching practices. FEMS Microbiol Lett 364:1–6. https://doi.org/10.1093/femsle/fnx179.
29. Brinkley-Etzkorn KE. 2018. Learning to teach online: measuring the influence of faculty development training on teaching effectiveness through a TPACK lens. Internet High Educ 38:28–35. https://doi.org/10.1016/j.iheduc.2018.04.004.
30. Dewsbury BM, Brame CJ. 2019. Inclusive teaching. CBE Life Sci Educ 18:fe2. https://doi.org/10.1187/cbe.19-01-0021.
31. Addy TM, Reeves PM, Dube D, Mitchell KA. 2021. What really matters for instructors implementing equitable and inclusive teaching approaches. J Educ Devel 40:1–48. https://doi.org/10.3998/tia.182.
32. Amundsen C, Wilson M. 2012. Are we asking the right questions?: a conceptual review of the educational development literature in higher education. Rev Educ Res 82:90–126. https://doi.org/10.3102/0034654312438409.
33. Asai DJ. 2020. Race matters. Cell 181:754–757. https://doi.org/10.1016/j.cell.2020.03.044.