CONVERGE Training Modules: A free online educational tool for hazards and disaster researchers and practitioners

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The National Science Foundation-supported CONVERGE facility was established in 2018 as the first social science-led component of the Natural Hazards Engineering Research Infrastructure (NHERI). Headquartered at the Natural Hazards Center at the University of Colorado Boulder, CONVERGE identifies, trains, connects, and funds researchers across disciplines in the hazards and disaster field. This article provides an overview of one of our most widely used tools, the CONVERGE Training Modules. These free, interactive, online trainings are designed for students, early career professionals, and others who are new to hazards and disaster research and practice. Since July 2019, our team has released 10 modules that cover a range of foundational topics in hazards and disaster research, including Institutional Review Board procedures, conducting emotionally challenging research, cultural competence, collecting and sharing perishable data, social vulnerability, and disaster mental health. In addition, CONVERGE offers advanced trainings in specialized topics such as broader ethical considerations for hazards and disaster researchers, reciprocity, gender-based violence in fieldwork, and public health implications of hazards and disaster research. Between July 2019 and November 2022, 6,311 unique users registered for the modules, and these users logged 7,222 module completions. Of the module completions to date, the largest percentage of users completed only one (46.0%) of the available trainings, although a small group of "superusers"—whom we surveyed for this article—have completed all or almost all of the available modules. When asked why they planned to complete the modules at the time of registration, most users indicated that it was to fulfill a classroom or other educational requirement (51.2%), for personal interest/to learn more (9.0%), or to prepare for or to support research (7.1%) or practice-oriented activities (5.8%). In addition to providing more information regarding module users, this article details the development of the technology and discusses the impact and success of this tool for transferring knowledge and skills to the hazards and disaster research and practice community. We conclude with a discussion of future directions for this research-based educational intervention.

Introduction

Disasters occur at the intersection of natural, built, and social environments (Tierney, 2019; Peek, 2022). As these events unfold, researchers of various experience levels and disciplines—including engineers, social scientists, physical scientists, and others—converge in the field to collect valuable perishable data before it disappears and memories fade (Berman et al., 2020; Oulahen et al., 2020; Wartman et al., 2020). Traditionally, this data has been gathered mostly in isolation, with researchers working in disciplinary silos to study a particular aspect of the event. However, as disasters become more frequent and complex, there is a need to develop enhanced training that supports interdisciplinarity, expands the breadth and depth of research (Louis-Charles et al., 2020; Peek and Guikema, 2021), and prepares the workforce to respond to disasters and public health emergencies in a timely and appropriate manner (Langan et al., 2017). Investing in the education of current and future generations of hazards and disaster researchers and practitioners can help address these gaps and provide opportunities for fostering convergence across organizational and disciplinary boundaries (Peek et al., 2020a).

With funding from the National Science Foundation (NSF), CONVERGE was established in 2018 as the first social-science led facility in the broader Natural Hazards Engineering Research Infrastructure (NHERI) network. CONVERGE advances ethically-grounded convergence research that is problem-focused and solutions-based (Peek et al., 2020b; Peek, 2022). As part of our mission, our CONVERGE team identifies functionally and demographically diverse researchers, brings together disciplinary-specific research networks, offers multidisciplinary training opportunities, and funds convergence research and data publication activities.

In this article, we describe one of the facility's most widely used tools, the CONVERGE Training Modules.[1] Specifically, we provide an overview of the 10 currently available modules, with a focus on the fundamental knowledge and skills that we seek to share with the rapidly growing number of students and professionals with an interest in hazards and disaster research and applications. By focusing on developing methodological, theoretical, and applied skills, the CONVERGE Training Modules aim to prepare a diverse multidisciplinary workforce for increasingly complex 21st-century environmental and social challenges that turn natural hazards into disasters (National Research Council, 2006; Langan et al., 2017; Peek et al., 2020a).

Overview of the CONVERGE Training Modules

The CONVERGE Training Modules are free, web-based trainings that cover a range of foundational topics in hazards

and disaster research, including Institutional Review Board (IRB) procedures, conducting emotionally challenging research, cultural competence, collecting and sharing perishable data, social vulnerability, and disaster mental health. In addition, CONVERGE offers advanced trainings in specialized topics such as broader ethical considerations for hazards and disaster researchers, reciprocity, gender-based violence in fieldwork, and public health implications of hazards and disaster research.

All training modules are accessible through the CONVERGE website, and the training module landing page has been viewed more than 27,000 times since its launch.[2] Between July 2019, when the first module was released, and November 2022, 6,311 unique users registered for the CONVERGE Training Modules. Once registered, users can complete any of the available modules. Each module takes between 30 and 60 min to complete. As of November 2022, registered users had completed a total of 7,222 modules. A summary of the number of completions, by module, is included in Table 1.

The CONVERGE Training Modules take an all-hazards approach and draw on examples from natural hazards such as earthquakes and hurricanes, technological disasters such as oil spills and chemical releases, public health emergencies such as the COVID-19 pandemic, and willful human-caused disasters such as the 9/11 terrorist attacks. The modules also use U.S.-based as well as international case studies to illustrate key points. While each CONVERGE Training Module focuses on a distinct topic of relevance to researchers and practitioners across disciplines, there are seven shared themes (Tessier and Tessier, 2015) that are integrated across all the available modules: research ethics, social stratification and inequality, power differentials, interdisciplinary collaboration and convergence research, research methods, data management and use, and practical applications of research (see Figure 1). These shared themes—which are described briefly in the subsequent sections—are designed to help focus learners *within* each module on issues critical to the field, while also revealing important connections *across* all the modules.

Research ethics

Each of the available modules addresses ethical consideration of hazards and disaster research and practice; this topic is central to both the *IRB Procedures and Extreme Events Research* and the *Broader Ethical Considerations for Hazards and Disaster Researchers* modules. The IRB module introduces users to the egregious ethical violations in medical research that led to the development of the modern IRB in the United States. The module then outlines the steps required to apply for and receive IRB approval and provides strategies and recommendations for submitting a successful IRB application for hazards and disaster research. For example, to facilitate IRB approval for quick response studies, the module suggests that hazards and disaster researchers develop pre-event generic protocols, such as the Rapid Acquisition of Pre- and Post-Incident Disaster Data Study protocol, that are applicable to a range of potential disaster scenarios (National Institute of Environmental Health Sciences, 2021; Peek et al.,

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1 The CONVERGE Training Modules are just one of the educational tools and products produced by CONVERGE researchers and our partners. We encourage readers to visit https://converge.colorado.edu/ to access additional resources such as the CONVERGE Extreme Events Research Check Sheets, data publication training materials, and recorded webinars and virtual forums.

2 Visit: https://converge.colorado.edu/resources/training-modules.

TABLE 1 Summary of CONVERGE Training Modules released between July 2019 and November 2022.

Training module title	Description	Release date	Number of completions	Funding source(s)
Social Vulnerability and Disasters	This module focuses on vulnerability to hazards and disasters, with an emphasis on population groups that have been identified in the literature as especially at risk to the adverse effects of extreme events (Adams et al., 2019b; Adams et al., 2022)	July 2019	2,530	National Science Foundation (NSF) with supplemental funding from the Centers for Disease Control and Prevention (CDC)
Disaster Mental Health	This module examines mental health outcomes associated with disasters, with a particular emphasis on risk factors that make certain populations vulnerable to poor disaster mental health outcomes over time (Adams et al., 2019a; Evans et al., 2021b)	October 2019	1,544	NSF and CDC
Cultural Competence in Hazards and Disaster Research	This module focuses on culturally competent research and offers guidance on how hazards and disaster researchers can build cultural awareness, knowledge, sensitivity, and competence as a multi-step and ongoing process (Wu et al., 2020a; Wu et al., 2022)	March 2020	1,055	NSF
Institutional Review Board (IRB) Procedures and Extreme Events Research	This module introduces users to IRB procedures and provides advice regarding how to work with IRBs to ensure ethical approaches to extreme events research (Wu et al., 2020b)	June 2020	502	NSF
Conducting Emotionally Challenging Research	This module defines emotionally challenging research and highlights the ways that recognizing researchers' emotions can lead to more ethical and methodologically sound research practices in the context of extreme events (Bermudez Tapia et al., 2020)	September 2020	378	NSF
Understanding and Ending Gender-Based Violence in Fieldwork	This module examines gender-based violence in field research and provides an in-depth exploration of misconceptions, real life scenarios, and strategies for safer and more gender-just fieldwork practices (Heinze et al., 2021)	March 2021	156	NSF
Broader Ethical Considerations for Hazards and Disaster Researchers	This module focuses on broader ethical considerations for research. It describes how researchers can navigate ethical landmines while developing a flexible and robust ethical toolkit for researching hazards and disasters (Adams et al., 2021)	April 2021	592	NSF and CDC
Collecting and Sharing Perishable Data	This module defines perishable data and provides recommendations to address ethical and logistical challenges for collecting and sharing this type of data after disasters (Evans et al., 2021a)	July 2021	276	NSF and CDC
Reciprocity in Hazards and Disaster Research	This module focuses on the reciprocal relationship between researchers and disaster-affected people and communities with an emphasis on ensuring that research is beneficial for participants as well as the research community (West et al., 2022)	February 2022	53	NSF with supplemental funding from the U.S. Geological Survey (USGS)
Public Health Implications of Hazards and Disaster Research	This module is designed to help users identify and explain to others how hazards and disaster research can help improve the health of disaster-affected populations (Hansen et al., 2022)	April 2022	136	NSF and CDC

2021). The *Broader Ethical Considerations* module extends the scope of the IRB module with discussions on additional ethical challenges in hazards and disaster research that fall outside the purview of institutional review committees. This module also encourages users to think about how they might respond to thorny ethical dilemmas in the field through developing their own ethical toolkit for conducting hazards and disaster research.

Social stratification and inequality

Disasters are inherently "social in nature" (Quarantelli, 1992; Mileti, 1999, p. 3). When natural hazards turn into human disasters, they manifest through pre-existing and exacerbated vulnerabilities of the social system that influence the susceptibility to adverse outcomes among diverse populations

FIGURE 1
CONVERGE Training Module series cross-cutting themes.

(Bullard, 2008; Tierney, 2019; Yellow Horse et al., 2020).
Accordingly, each of the CONVERGE Training Modules
centers considerations of social stratification and inequality.
For example, the *Social Vulnerability and Disasters* module
examines the socioeconomic and political root causes of
disaster vulnerability, summarizing decades of research
showing that marginalized social groups are more exposed to
hazard risk and therefore susceptible to disaster harm and
unequal losses. Older adults are one example of a socially
vulnerable population; their risk may be due to intersecting
factors such as living in isolation, having limited financial
resources, or experiencing chronic health issues and
disabilities that interfere with daily functioning. Together,
these factors influence their ability to anticipate, cope with,
resist, and recover from disasters.

Power differentials

Each of the training modules explores power differentials
within and between sociodemographic groups. For example, the
Understanding and Ending Gender-Based Violence in Fieldwork
module discusses power differentials as related to a researcher's
gender and other identities, such as race, social class, and
sexuality. The module is concerned with how these identities
intersect and influence experiences of harassment,
discrimination, and assault in research and other professional
work. This module begins by defining gender-based violence,
debunking various myths and misconceptions, and providing
examples of gendered violence in field research. These range from
verbal harassment of female researchers by research participants
to institutionalized discrimination against women researchers in
academia. It then presents barriers to reporting gender-based

violence and concludes with a list of strategies that researchers
can use to reduce these instances in the field, laboratory, and
beyond. Some examples of strategies include restating researcher
position and emphasizing work during data collection, removing
problematic participants from a study, securing a local ally or
translator as a chaperone, and garnering institutional support to
dismantle gendered systems of privilege and oppression in
research.

Interdisciplinary collaboration and convergence research

The CONVERGE facility focuses on encouraging
communication, coordination, and collaboration among multi-
and interdisciplinary teams. Each module is written with a broad
audience of researchers and practitioners in mind. The modules
draw upon research from multiple disciplines while emphasizing
differences and similarities in their approaches. The *Collecting and
Sharing Perishable Data* module, for instance, summarizes the
varying timelines and methods used to collect perishable data
across disciplines within engineering, the natural sciences, and
the social sciences. The modules also emphasize the importance
of developing interdisciplinary research teams, and the challenges
that may emerge in the process of doing so. The modules encourage
users to develop a convergence orientation, which entails working
across disciplinary silos to better characterize vexing problems and
develop locally-grounded participatory solutions (Peek et al.,
2020b). The *Broader Ethical Considerations for Hazards and
Disaster Researchers* module, for example, has an entire lesson
dedicated to the need to engage in convergence research to
address vexing social, economic, environmental, and technical
challenges.

Research methods

Each module discusses a variety of methodological approaches used by hazards and disaster researchers across disciplines. For example, the *Disaster Mental Health* module highlights qualitative and quantitative social science methods through case study vignettes. One of these case studies showcases how investigators used the mental component summary scale as a diagnostic tool to systematically examine mental health outcomes among Hurricane Katrina survivors. In the *Conducting Emotionally Challenging Research* module, one lesson describes how some methodological approaches and study designs may present emotional challenges for researchers themselves. For example, those analyzing secondary data focused on mortality from earthquakes, floods, heat waves, and other natural hazards may experience emotional challenges as they discover unequal patterns in terms of who lives and dies during a disaster. In the *Cultural Competence in Hazards and Disaster Research* module, we recommend methods and approaches for enhancing cultural knowledge and sensitivity, such as engaging in self-reflection or attending culture-specific trainings.

Data management and use

Each of the training modules underscores the need to appropriately and ethically manage and share data with other researchers, research participants, and policy and practice stakeholders. The *Reciprocity in Hazards and Disaster Research* module describes data sharing as one form of reciprocating, or giving back, to the people who participated in the research. The module highlights how participatory approaches, such as Community-Based Participatory Research, actively involve research participants in data collection and ownership of the research process. These methods help to honor and reflect the experiences, perspectives, and expertise of the people who disasters impact. The *Collecting and Sharing Perishable Data* module discusses several rationales for disseminating data, such as increasing transparency of publicly funded research, allowing other researchers to reproduce or verify findings, and enabling others to ask new questions of existing data.

Practical applications of research

Each of the modules showcases the practical applications of hazards and disaster research, demonstrating how rigorous convergence-oriented research can help researchers to better characterize problems while also contributing to evidence-based solutions. Research applications are at the center of the *Public Health Implications of Hazards and Disaster Research* module, which presents case studies from multiple disciplines and helps users identify ways that these studies inform public health practice and policy. For instance, one case study presents research examining seafood contamination after the Deepwater Horizon Oil Spill and describes how monitoring polycyclic aromatic hydrocarbon levels allowed the Food and Drug Administration to develop risk criteria and thresholds for allowable levels in Gulf seafood. These criteria directly influenced public health policy through government orders to close the fisheries to protect the health and safety of affected communities. After users read through this and the other case studies in the module, we invite them to apply their knowledge by completing a series of interactive activities that can be completed independently or in a classroom setting.

Training module design and content

The CONVERGE Training Modules employ several e-learning best practices to engage users, such as including learning objectives and specific real-world examples (Centers for Disease Control and Prevention, 2013; Wood et al., 2019). Each module includes engaging, interactive multimedia content that typically features one or more photographs per topic page. For example, in the *Conducting Emotionally Challenging Research* module, we use photographs of damaged and destroyed buildings in the 2015 Nepal earthquake to make the point that researchers—regardless of discipline—need to be emotionally prepared to conduct research in landscapes where there may be injuries, deaths, widespread destruction to the built environment, and disruption of human activities (see Figure 2). We also develop infographics, slideshows, case studies, and critical thinking activities to engage users and ensure that they are grasping the wide range of content introduced in the modules. In addition, we embed resource links and references throughout each lesson so that interested users can follow up with other publications and websites outside of the training module platform.

To maintain users' attention as they progress through each module, we include knowledge checks consisting of two multiple choice questions at the end of each lesson. A progress bar and navigational tools guide learners through the content. At the end of the module, users can take a 10-question quiz worth one contact hour of emergency management training through a partnership with the International Association of Emergency Managers (IAEM) certification program.

Each module offers a list of downloadable resources including links to relevant datasets, additional trainings, and online tools. We also publish a CONVERGE Annotated Bibliography that summarizes the literature that informed the development of each module so that users can read further about the module topic and delve more deeply into the original sources upon which the training is based. In addition, we have worked closely with university professors and other end users to develop the CONVERGE Assignment Bank, which as of November 2022 includes 13 sample assignments for use in undergraduate and graduate level courses in engineering, the social sciences, and public health (see Figure 3). The bibliographies and assignments are available for free on the CONVERGE website and have been downloaded 1,881 times as of December 2022.

The training modules and supplementary materials meet the required accessibility standards of the University of Colorado Boulder. These standards include presenting material that can be used and accessed by users regardless of their physical, auditory, motor, or cognitive abilities.

EXAMPLE

|| Emotions and Damage Assessments

Engineers were deployed after the 2015 Nepal earthquake to conduct field observations of damage to the built environment in order to study the correlations between ground motion intensity and damage severity. Witnessing the degree of damage as evidenced in these photos can provoke a wide range of emotional reactions within researchers, especially if they are not trained to process these emotional aspects of their research.[1]

FIGURE 2
Example case study from the CONVERGE *Conducting Emotionally Challenging Research* Training Module. **(A)** Collapse of the Basantapur Tower in the Kathmandu Durbar Square. **(B)** Undamaged buildings opposite of the Basantapur Tower in the Kathmandu Durbar Square. **(C)** Collapse of four 5- or 6-story old masonry buildings. **(D)** Collapse of a 4-story masonry building. Adapted from (Goda et al., 2015).

Training module development and review process

At CONVERGE, a full-time research associate (Adams, lead developer), a part-time graduate research assistant (Evans, co-lead developer), and the principal investigator (Peek) oversee the conceptualization and development of the training modules to ensure a consistent structure, approach, and voice in the delivery of content. In addition, our core team seeks out and engages with subject matter experts from various disciplines and institutions to develop each unique module. The lead authors of the available modules hail from public health, sociology, social work, and anthropology, and we have engaged additional collaborators and reviewers from across the social sciences and engineering.

The need for the training module series was established in the initial NSF proposal for CONVERGE written by Peek. There, she identified several topical areas to focus on in the trainings, such as research ethics, perishable data collection, and conducting team-based interdisciplinary research. As the series has evolved, our core team has established additional areas for training based on

researcher and practitioner demand, our own areas of interest and expertise, and funder priorities.

Regardless of how we decide on the module topic, we ensure that one lead author is designated for each module and that somewhere between two to six additional co-authors are involved in the development process. The authors then follow a common stepwise process in developing the module content. That process always begins with an extensive review of the available literature on the focal topic. The authors construct a detailed module outline in a shared document, which is thoroughly reviewed and vetted by our core development team. Once the outline is finalized, the primary authors begin drafting the text in a collaborative fashion, as they identify case studies and other empirical content for inclusion. When a full draft is complete, the authors add knowledge checks and quiz questions, compile supplementary resources to share, choose images for case studies, develop graphics and interactive exercises, and format references.

Each module is reviewed by the principal investigator (Peek) at the outline phase as well as at the 50%, 85%, and 95% draft stages. If the module writing is being led by an author outside the core team, then the two other members of this team (Adams and Evans), in
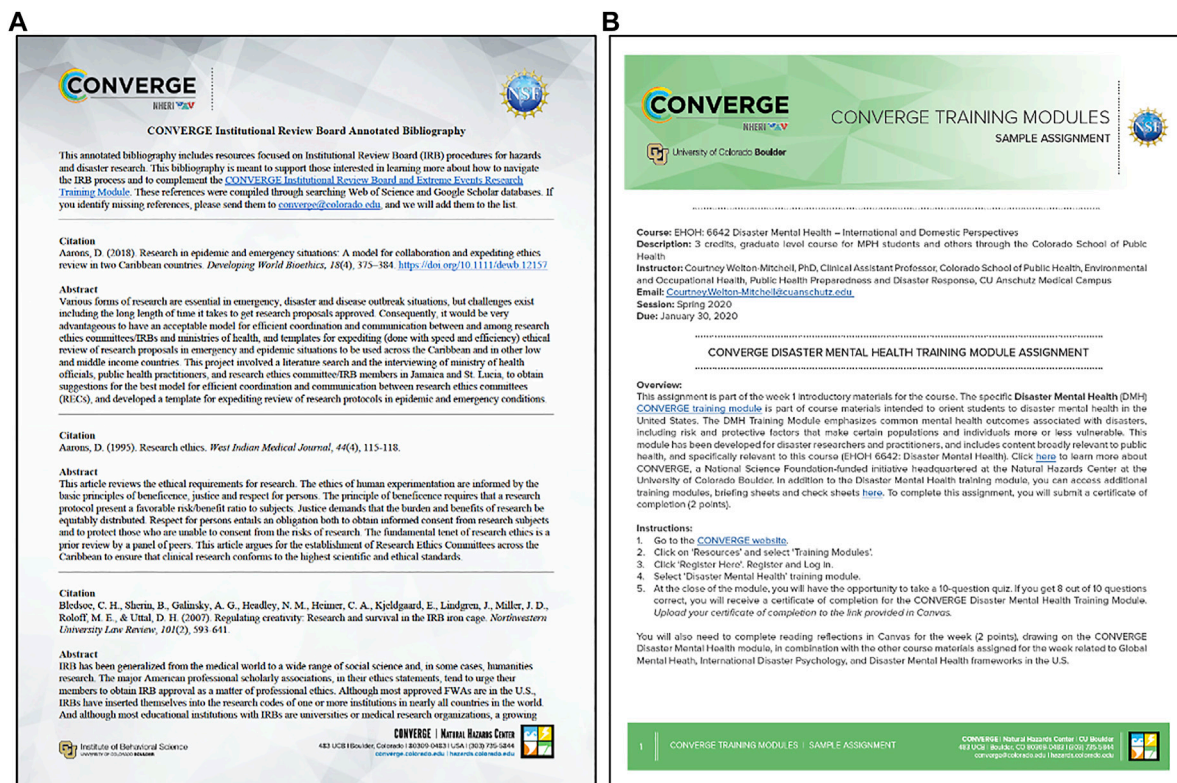
FIGURE 3
The CONVERGE Training Modules Series includes supplementary materials such as Annotated Bibliographies **(A)** and Sample Classroom Assignments **(B)**.

addition to one or two subject matter experts at the Natural Hazards Center, will also review at these stages. For modules that were supported by additional funding from federal agencies such as the CDC and the USGS, there are at least two additional subject matter experts from these agencies who also review at these key stages in the development process. Each reviewer provides written feedback in the form of overarching comments and detailed tracked changes in the shared document. This multi-stage review process leads to multiple revisions of the content, often ranging from somewhere between 10 and 20 drafts. Given the number of authors and reviewers involved, the use of collaborative software for concurrent writing, reviewing, and revising has been vital to the success of this overall effort.

When a final draft is complete, the core development team (Adams and Evans) transfers the content into the online learning management system, LearnDash. LearnDash is a WordPress plugin created by leading learning industry professionals that provides practical and experience-driven guidance for individuals and organizations developing online courses. This system is dynamic and allows the development team to make updates and additions before or after publication.

Once the module is fully implemented in LearnDash, somewhere between three to seven undergraduate research assistants at the Natural Hazards Center review the formatting and test the module for functionality across a range of devices and internet platforms. They provide written feedback, and then our team incorporates any necessary changes to ensure module functionality. Depending on availability, between four to eight graduate research assistants and professional research associates at the Natural Hazards Center provide a final substantive review of the module using a standardized review sheet. Once all reviews are complete, the development team conducts a final revision and careful review before publishing the module on the CONVERGE website.

As a brief aside, it is worth noting that our commitment to an extensive and rigorous review process was solidified by our experience finalizing the first module in this series. That module—*Social Vulnerability and Disasters*—was created in partnership with scientists at the CDC who provided extensive reviews throughout the writing process. Their multiple detailed reviews pushed us to establish the basic structure that we have carried through each module completed in the years since. As our core team neared completion and readied to release the *Social Vulnerability* module, we invited nearly 30 NSF-funded Research Experience for Undergraduates (REU) students who were participating in the 2019 NHERI summer program to review the module. We then met with those students online. Not only was it inspiring to receive their insights, but it was also vital to hear from members of our core intended audience. For example, it was those NHERI REU students who suggested that we add even more interactive content and integrate knowledge checks at the end of each lesson, among their many other useful

suggestions. Each subsequent module has been further strengthened as we have continued to learn from students and seasoned experts in the field who have generously agreed to review the modules.

Training module dissemination

At the CONVERGE facility, we participate in multiple dissemination activities to ensure robust engagement with new modules as they are produced. We begin by working with the NHERI communications lead to develop a news release that will be shared through the NHERI network and the Natural Hazards Center's website and social media platforms. Our team has also developed a collection of listservs and message boards where we post tailored announcements each time a new module is released. Next, depending on the specific focus of the module, we identify relevant professional organizations and contacts across several academic disciplines and policy and practice communities, and send them an email announcing the release of the module. To reach public health practitioners and researchers, we submit paperwork to the TRAIN Learning Network for approval to list the training module as a course on their website. In addition, our team sends a personalized email to all the lead authors whom we cite in the module, notifying them that we highlighted their work and asking them to share the resource through their own scholarly networks. Finally, we send a mass email out to all CONVERGE subscribers who have signed up for training module updates, notifying them of the release of each new module. As of December 2022, 811 people have subscribed for such updates through the CONVERGE website.

In the weeks following the release of a module, we host a 30-min online demonstration webinar. During these brief sessions, one or more of the lead authors provides an overview of a module's content and a demonstration of its functionality. We widely promote these webinars through our networks and post and share the captioned webinar video recording on the CONVERGE website.[3]

Our team works to further promote the CONVERGE Training Modules by presenting posters and verbal presentations at interdisciplinary conferences and meetings, including the annual Natural Hazards Workshop and Researcher's Meeting, the NHERI Summer Institute and NHERI Summit, the National Earthquake Conference, the National Hurricane Conference, and the American Public Health Association's Annual Meeting, among other venues.

We also disseminate the modules more broadly through evaluation and overview articles published in peer reviewed journals (Peek et al., 2020b; Evans et al., 2021b; Adams et al., 2022; Peek, 2022; Wu et al., 2022). For example, in Wu et al. (2022), the authors summarize the key intellectual contributions of the *Cultural Competence for Hazards and Disaster Researchers* module, while also describing the development and dissemination process. This is an important example of moving the substantive content and lessons learned from developing a tool for technology transfer into the peer-reviewed literature.

In addition to these formal dissemination and evaluation activities, we also regularly review the number of people who have completed each module and assess their background characteristics to ensure that we are reaching our desired audiences through our different dissemination activities. We periodically share these statistics, as well as information on the number of webinar attendees and webpage views, with our funders and other interested persons.

Training module registrants and evaluation of module users

Registration data collected between July 2019 and November 2022 indicate that almost three-quarters (74.4%) of registrants are undergraduate or graduate students. When asked about their primary affiliation, almost two-thirds indicated an academic institution, 12.1% indicated federal, local, state, or federal government, and 5.4% indicated a non-profit at the time of signing up for the modules. A small number of registrants indicated the private sector, media, or the voluntary sector as their primary work category.

To establish each users' level of experience in the hazards and disaster field, we ask all registrants to self-identify as a core, periodic, situational, or emerging researcher or practitioner. This workforce typology captures stages of career development and commitment to the field through the established categorization of the National Research Council (2006) and extended by Peek et al. (2020a). Table 2 provides a brief definition for each category in the typology and shows the percentage of registrants by category. As indicated, most registrants self-identify as emerging researchers or practitioners (65.9%), followed by core (16.0%), periodic (10.3%), and situational (7.8%).

CONVERGE Training Module registrants come from a variety of disciplinary backgrounds. Just over one-quarter of all registrants affiliate with disciplines in the social sciences (27.4%), with the next highest percentage of registrants affiliating with emergency management or disaster science (18.3%). The training modules have also attracted registrants in education (11.6%), public health (11.2%), and engineering (9.4%). As shown in Table 3, registrants also come from medicine/nursing, natural sciences, humanities/law, business, and formal sciences.

When asked at the time of sign up to choose the different reasons for completing a CONVERGE Training Module, most registrants indicated that it was to fulfill a classroom or other educational requirement (51.2%). Other reasons included personal interest/to learn more (9.0%), to prepare for or support research (7.1%), or practice-oriented activities (5.8%). Almost one-fifth of registrants chose more than one of the response options provided (17.9%).

Qualitative evaluation of training module "superusers"

Of the thousands of module completions to date, nearly half of registrants completed only one (46.0%) of the available trainings (see Figure 4). This relatively low return rate to complete additional

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3 Visit: https://converge.colorado.edu/category/webinars/.

TABLE 2 CONVERGE Training Module registrants by level of involvement in the field.

Typology of levels of involvement [adapted from Peek et al., 2020a, pp. 1078, 1080]	N (%)
Emerging Researcher or Practitioner: Includes students and others who are new to the hazards or disaster field and who are still learning about its disciplinary, multidisciplinary, or interdisciplinary histories, theories, methods, and approaches. Emerging researchers and practitioners may have limited experience in the field or may not have yet conducted their own original empirical research.	4,136 (65.9)
Core Researcher or Practitioner: Strongly self-identifies as a hazards or disaster researcher or practitioner, has a deep commitment to the field, and has engaged in hazards or disaster research or practice for a sustained amount of time.	1,004 (16.0)
Periodic Researcher or Practitioner: Is not primarily engaged in hazards or disaster research or practice but focuses on related topics from time to time throughout one's professional career.	644 (10.3)
Situational Researcher or Practitioner: Not previously trained or involved in the hazards or disaster field but had the opportunity to study new phenomena or processes based on a situational event; for example, a researcher who undertook a study after their community was affected by a major disaster.	491 (7.8)

TABLE 3 CONVERGE Training Module registrants by discipline.

| Discipline	N (%)
Social Sciences (e.g., anthropology, geography, political science, psychology, sociology, urban planning, *etc.*)	1,122 (27.4)
Emergency Management/Disaster Science	747 (18.3)
Education	476 (11.6)
Public Health	458 (11.2)
Engineering	386 (9.4)
Medicine/Nursing	270 (6.6)
Natural Sciences (e.g., biology, chemistry, earth science, ocean sciences, physics, space science, *etc.*)	261 (6.4)
Humanities/Law	163 (4.0)
Business	153 (3.7)
Formal Sciences (e.g., computer science, mathematics, statistics, *etc.*)	53 (1.3)
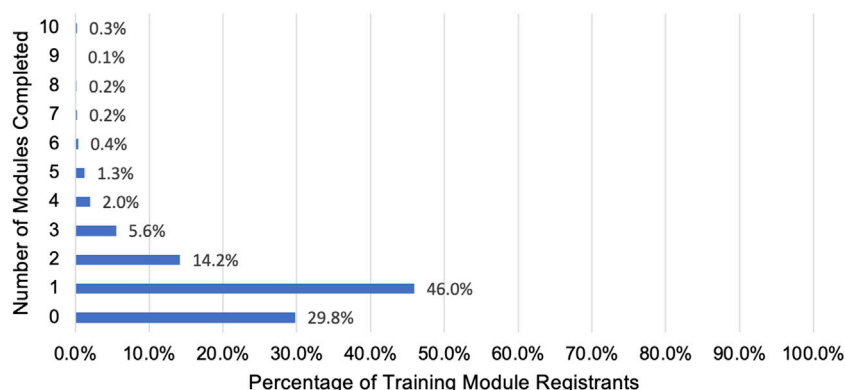
FIGURE 4
Number and percentage of CONVERGE Training Modules completed by each registrant.

modules is almost certainly because our primary users for these modules are students, and many of those students complete the modules based on required classroom assignments or extra credit opportunities. In short, the data seem to indicate that professors assign these modules, and students complete the assignment but do not necessarily return to complete additional trainings.

At the other end of the spectrum, our analysis of the user registration data revealed that there were also 33 very active

users—people whom we've come to fondly refer to as "superusers"—who have successfully completed eight or more of the 10 currently available modules. To learn more about their reasons for taking such a high number (or all) of the available modules, we administered a brief qualitative survey *via* Qualtrics to the 33 superusers in October 2022. We asked the following questions: 1) What motivated you to complete multiple CONVERGE Training Modules? 2) What have you found most helpful or effective about the CONVERGE Training Modules? 3) What do you recommend we change or consider doing differently in the future with the CONVERGE Training Modules? and 4) Finally, anything else you want to add or share?

We received open-ended responses from 13 of the superusers. When asked about the motivation to complete so many modules, several of the respondents wrote that they initially completed a few of the training modules as a requirement, such as for a class assignment, a job-related task, or a pre-requisite for a grant proposal. These respondents indicated that they then continued to take more trainings due to personal interest in the topic and the desire to enhance their knowledge. For example, one respondent indicated that while they were initially introduced to the modules as a class assignment, they "continued to take the CONVERGE modules because they were interesting and insightful." Other respondents shared that they took the modules to refresh knowledge on the various topics and decide whether they should use them as assignments for the classes they teach. Superusers who were completing their own graduate studies also indicated that the modules transferred important information and helped them to build their burgeoning research skills. As one respondent said:

> "My second motivation is academic. Through the modules designed by CONVERGE, learners and professionals have the resources to strengthen their skills and operational capacity. As far as I am concerned, these modules provided me with appropriate knowledge to prepare my thesis."

For the second question, which asked respondents about what they found most helpful or effective about the CONVERGE Training Modules, many indicated that they appreciated the ease and accessibility of the modules. For instance, one respondent said:

> "The modules are an incredibly efficient way to get familiar with a new topic or literature base relevant to hazards and disasters. I love how the modules help contextualize a wide range of research and case studies by showing how they're related to the module's topic."

Other respondents mentioned specific aspects of the module, such as the knowledge checks, which "reinforce what was learned in each module," and the case studies, which "help cement a concept in [the] mind by providing a tangible example."

When asked about recommendations for improving the CONVERGE Training Modules, some of the respondents indicated that they had no specific recommendations. Others underscored that they would simply like even more of what is already available, such as case studies and additional resource

links. Among those who provided written recommendations for changes through the survey, a few mentioned the need to update materials and provide new links to resources as they become available in the future (something that is possible because of the dynamic LearnDash platform). Several respondents also requested the ability to access the modules in a different format. For example, one respondent wanted to be able to download the module as a PDF and another expressed a desire for individual landing pages for each training module so that "when the link/URL to a module is shared on social media (like Twitter) the link would convert to an image with a brief text description."

When asked if there was anything else they would like to share, most respondents expressed gratitude to our CONVERGE team for developing the training modules. One respondent also provided a suggestion for a new training module that focuses on "navigating social science research within various institutions, including government, academic, industry and non-profit."

Although we only surveyed a small sample of superusers for this article, we have a dedicated email account for CONVERGE where registrants can and do contact us with questions or comments about the modules. It is through this email that we have received suggestions for module topics, additional publications, and other resources to cite in the available modules. We also use this dedicated email account to reach out to educators who have assigned our modules for courses and invite them to contribute to the CONVERGE Assignment Bank.

Quantitative evaluation of training module users

In the years since the launch of the CONVERGE Training Module series, we have published two larger-scale quantitative evaluations of changes in knowledge, skills, and attitudes among users who completed our first two (and most-completed, to date) modules. These papers, which we summarize here, fill a vital gap in the evaluation literature of hazards and disaster-focused tools and technologies.

In our evaluation of the *Social Vulnerability and Disasters* module, we found significant differences in perceived knowledge, skills, and attitudes before and after taking the module (Adams et al., 2022). On average, users experienced the greatest change in self-reported skills, suggesting that they perceived their methodological skill set for studying socially vulnerable populations as the most impacted by completing the module. Kruskal–Wallis statistical tests (Kruskal and Wallis, 1952) revealed that certain subgroups of users experienced greater perceived benefits from the module. Specifically, we found that students, members of historically underrepresented populations, such as women and people of color, and those new to or less experienced in the field had the greatest perceived increase in knowledge and skills.

In our evaluation of the *Disaster Mental Health* module, we similarly found increases in all three measures after completing the module, with the greatest benefit for self-reported skills for conducting research on disaster mental health (Evans et al.,

2021b). Those who identified as a student, white, female, and who resided in the United States; as well as those who reported having less experience in the field, having a high school diploma/GED as their highest degree, and being affiliated with an academic organization reported the greatest benefit in terms of knowledge gained. Students, emerging researchers and practitioners, and those with a high school diploma/GED as their highest degree also experienced a significantly greater benefit in terms of skills gained from completing the module.

Conclusion and future directions

The CONVERGE Training Modules represent a new technology in the hazards and disaster field designed to offer free and accessible education on foundational topics of enduring concern. Grounded in a broader vision for rapidly disseminating and democratizing access to knowledge (Peek, 2022), these modules synthesize decades of literature across disciplines to transmit key empirical, methodological, theoretical, and ethical insights. They also draw on e-learning best practices and interactive strategies to engage users and help build vital skills of relevance to researchers as well as practitioners.

As of Novembe 2022, the available CONVERGE Training Modules reached more than 6,300 unique users who are predominantly students and emerging researchers and practitioners hailing from multiple disciplinary backgrounds. By helping to train a diverse next-generation of the interdisciplinary hazards and disaster workforce (Evans et al., 2021b; Adams et al., 2022), the modules are advancing convergence-oriented research needed to address increasingly intense and frequent extreme events (Peek et al., 2020b).

Moving forward, we will continue to survey the user base to learn more about their desires for future module topics. We also plan to conduct additional systematic qualitative evaluations with a broader range of users to learn more about return rates and the tool's long-term impacts.

In addition to the 10 modules already released, we have additional modules in development and will continue to build upon both the foundational as well as advanced topical areas that we have already released. For example, over the next 2 years, we plan to develop and release modules focused on positionality in hazards and disaster research, decolonizing methodologies, social science and interdisciplinary methods for hazards and disaster research, and best practices for data publication and data reuse. Regardless of the module topic, we will continue to ensure that each module addresses the key shared themes that bind the series together.

As the complexity of the disaster landscape continues to evolve, so too must its research and practice in the field (Peek et al., 2020b). This includes promoting more interdisciplinary collaborations across academia and the public and private sectors, as well as involving researchers and practitioners from historically-underrepresented groups. For example, by offering modules in additional languages, such as Spanish, Korean, and Mandarin Chinese, we can reach a broader userbase. By working with partners fluent in languages other than English, we can advance the modules' global reach. In fact, we are in the process of collaborating with a member of the conflict research firm, Navanti Group, who offered to translate into French two of the available training modules that they use frequently with their humanitarian aid workers. As described by the Navanti Group's Global Director for Girls' Education and Gender Equality:

> "In a recent study in Burkina Faso and Niger, our research teams came back feeling conflicted about their inability to meaningfully address the needs of the individuals they were interviewing. I had used CONVERGE training in preparation for previous U.S.-based research on disasters and found that the module on *Reciprocity* directly spoke to the experiences of our research team. We are now using it with researchers in Somalia to prompt conversations on what a relationship of mutual benefit might look like in the communities with which we are working."

Given the demonstrated success of the CONVERGE Training Modules in fostering education within the hazards and disaster space (Evans et al., 2021b; Adams et al., 2022), offering the content in other languages can enhance their overall reach and impact while also fostering cultural competence (Wu et al., 2022). We therefore plan to translate the modules into additional languages in the future, as well as expand our practitioner audience through the incorporation of more examples and perspectives from those outside of academia. By collaborating with practice-oriented organizations to develop new modules, we will be able to best engage in effective technology transfer that focuses on the needs of the current and future hazards and disaster workforce.

Data availability statement

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

Author contributions

RA led the conceptualization and drafting of the manuscript, the data analyses, and several revisions. CE contributed to the drafting of the manuscript, the data analyses, and several revisions. LP led the overarching project and contributed to the conceptualization and drafting of the manuscript and several revisions.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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