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Engaging undergraduate students in research for disaster mitigation on campus

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Abstract

Disasters can incur risks to life, property, and the environment, whether caused by 'natural,' human-made, or technological hazards. However, mitigating some risks through effective planning and preparedness can lower exposure and vulnerability. Risk mitigation is particularly essential at institutions of higher education (IHE), where transient populations may be at greater risk. Thus, our study aimed to assess the disaster preparedness of a campus community at an IHE in the United States. We also aimed to identify strategies to support effective hazard mitigation planning and preparedness, the results of which may help foster a culture of preparedness on campus. To do this, undergraduate students developed and deployed a campus questionnaire to assess public risk perception and disaster preparedness. The questionnaire results (n=470) indicated a need for enhanced enrollment in emergency alert systems, more comprehensive disaster training, and increased awareness of campus hazards among the campus community, including visitors unfamiliar with the campus. Students used these results to develop hazard mitigation strategies, which they then presented and discussed with campus stakeholders at an end-of-semester stakeholder summit. Through this process, students directly engaged in disaster preparedness on campus. This study highlights the importance of fostering disaster preparedness at IHEs by assessing the campus community's perceptions and preparedness levels by engaging students in active learning to promote disaster risk reduction.

Keywords: hazard mitigation planning; risk perception; disaster preparedness; institutions of higher education; active learning.

Introduction

'Natural,' human-made, and technological hazards present risks to life, property, and the environment. While varying widely in origin and impact, any hazard can become a disaster if the demands on a local system exceed its capacity to respond and recover. Natural hazards (e.g., infectious disease outbreaks, hurricanes, and wildfires) have dramatically increased in their occurrence, duration, and intensity over the last 30 years, costing the United States over \$2.9 trillion in damages (National Oceanic and Atmospheric Administration [NOAA], 2024). The frequency and destruction caused by human-made hazards (e.g., cyberattacks and active shootings) and technological hazards (e.g., chemical spills and infrastructure failures) have also increased in recent decades (Cvetković et al., 2024). With that, individuals who lack access to low-barrier resources within their communities are much more vulnerable to the adverse effects of these hazards. A large subgroup of individuals in the United States considered especially vulnerable are students at Institutions of Higher Education (IHEs).

Since the inception of universities in the United States, many disasters have caused damage to campus property, life, and the overall community. Notable examples of natural disasters amongst IHEs include the Loma Prieta earthquake of 1989 at Stanford University (National Research Council [NRC], 1994) and Hurricane Andrew of 1992 at the University of Miami (Provenzo & Fradd, 1995), both of which caused extensive damage to campus



infrastructure and the surrounding environment. Examples of IHEs that were significantly altered by human-made disasters include those that experienced mass shootings, such as the University of Texas at Austin in 1966 (Ponder, 2018), at Virginia Polytechnic Institute and State University in 2007 (Fox & Savage, 2009), and Michigan State University in 2023 (Brown et al., 2024), all of which resulted in multiple fatalities (Blair et al., 2013). Notable technological disasters include the Kelly Barnes Dam failure of 1977, which inundated part of the Toccoa Falls Bible College campus and claimed many lives (Sanders & Sauer, 1979). These are a few of hundreds of events that showcase IHE's vulnerability to natural, human-made, and technological hazards.

Over 4,000 IHEs in the United States serve more than 15 million students annually (Spellings et al., 2009; Snyder & Dillow, 2010). Students are considered more vulnerable to multiple hazards due to their transience, financial instability, and lack of knowledge about or access to local resources (Tanner & Doberstein, 2015). IHEs are obligated to protect their students; however, IHEs face unique challenges that make implementing standardized practices and policies difficult, such as those related to hazard mitigation and disaster risk reduction. Campuses that reside over a vast geographic area, offer a multitude of unique departments and operational hours, and serve a growing, diverse student population are prone to struggle with promoting emergency and disaster preparedness across their systems, further exacerbating student vulnerability to disasters overall (FEMA, 2013).

Despite these challenges, IHEs can and should take action to foster a culture of preparedness amongst their students. Studies show that by developing, integrating, and regularly maintaining a current all-hazard mitigation plan, for example, IHEs may become more disaster resilient, thus improving campus health and safety overall (Jaradat et al., 2015). All-hazard mitigation plans include the "actions taken to reduce or eliminate long-term risk to human life and property from hazards" (FEMA, 1996, p. 7). Further, conducting frequent training exercises that promote the participation of a wide range of students and faculty, alongside developing strong community partnerships, are critical factors for fostering disaster-resilient campuses and promoting a stronger sense of preparedness, particularly in students (Kapucu & Khosa, 2013). In response to these challenges in IHE safety, this study focuses on students' preparedness and perceived risk at the University of Georgia (UGA), identifying key factors that influence resilience to disasters.

This research aims to enhance campus resilience using a conceptual framework rooted in social-ecological systems (SES). An SES framework considers the interplay between social and ecological factors while evaluating hazard risks and vulnerability (Berkes, Folke, & Colding, 2000). Furthermore, an SES framework is beneficial when observing disaster preparedness at IHEs because it integrates human behavior, institutional capacities, and environmental factors to reduce disaster risk (Walker & Salt, 2012). The active learning approach employed in this study also aligns with the SES framework by engaging students who contribute to the system's resilience. By framing the campus as a living laboratory, this research operationalizes the SES framework to foster a culture of preparedness that is locally tailored and actionable.

Additionally, this research considers recommendations from the Sendai Framework for Disaster Risk Reduction as it encourages academics and practitioners to "increase research for regional, national, and local application; support action by local communities and authorities; and support the interface between policy and science for decision-making" (United Nations Office for Disaster Risk Reduction [UNDRR], 2015, p. 23). We respond to this call by contributing to the interface of policy and science on our local campus, with the goal of increasing hazard mitigation and encouraging a shared culture of preparedness. Few studies have focused on engaging undergraduate students as active participants in campus disaster preparedness and mitigation efforts. Our study addresses this gap in disaster preparedness research specific to IHEs by integrating student-led research and active learning approaches to assess and enhance disaster preparedness and hazard mitigation at UGA. By addressing this gap in research, our study contributes to a growing body of literature that seeks to bridge theoretical knowledge and practical applications for disaster risk reduction at IHEs.

Indeed, students can be powerful actors for campus community health by participating in disaster risk reduction activities, including disaster preparedness education and training (Goddard et al., 2018; Patel et al., 2020). As a testament to this, undergraduate students who took the course *Disaster Policy* in 2023 and 2024 led this study. The course is offered during the spring semester at the Institute for Disaster Management (IDM) within UGA's College of Public Health. It encourages students to apply their disaster management knowledge through active learning and research. To do this, students use an interdisciplinary understanding of hazard mitigation for disaster risk reduction and sustainability, using the campus as a living laboratory (Gomez & Derr, 2021; Hossain et al., 2019). Highlighting the interdisciplinary nature of the study, the course satisfies general elective requirements and counts towards two undergraduate programs at UGA: the minor in disaster management and the sustainability certificate. Thus, students come from various home disciplines, including geography, health promotion, risk management and insurance, and more.

Methods

Study Design and Sample Population

The UGA campus is located in Athens, Georgia, and was founded in 1785 on what was once Cherokee, Yuchi, and Muscogee lands (Boney, 2000; UGA Public Service and Outreach [PSO], 2018). As the first public state-chartered University in the United States, UGA has a rich social and environmental history—from slavery and exploitation to restoration and representation (Dendy, 2003; Inwood & Martin, 2008). Like other campuses nationwide, the UGA campus faces potential risks from natural, human-made, and technological hazards. Since 1970, more than 100 storms, including a tornado, have impacted campus (UGA OEP, 2018).

This study selected current undergraduate students at UGA as primary research participants and active contributors to the research process, centered on a campus survey questionnaire. Undergraduate students constitute the largest and most transient segment of the campus population, making them particularly vulnerable during disasters due to their lack of familiarity with local hazards and emergency protocols (Tanner & Doberstein, 2015). Although a vulnerable population, undergraduate students are well-positioned to participate in research-based, experiential learning projects that connect academic theory with hands-on practical applications (Goddard et al., 2018). Focusing on undergraduates also ensured our research included the largest population group at UGA, reflecting a broad spectrum of campus experiences and perspectives. The text continues here.

Questionnaire Creation and Deployment

This study used a mixed-methods questionnaire featuring closed-ended and open-ended questions to gather information on participants' perceptions of campus hazards and disaster preparedness. The initial questionnaire was pre-tested by undergraduate students enrolled in the Disaster Policy course in 2023, after which students improved and deployed a pilot version of the questionnaire (n=185). In 2024, the questionnaire was revised and expanded for deployment with a larger sample population (n=470). During the revision process, students drew from established examples in the field, including FEMA surveys (2023) and academic literature (Kapucu & Khosa, 2013; Sutton & Tierney, 2006; Tkachuck et al., 2018). Working individually, in small groups, and as a class, students collaboratively constructed, modified, and refined potential questionnaire items. A class vote determined the final set of questions and their order.

The finalized 2024 questionnaire contained 12 questions. Participation was anonymous, voluntary, and not incentivized. Although the study was exempt from human subjects research oversight by the UGA Institutional Review Board, students completed certified training in social, behavioral, and internet research methods. Before conducting data collection, students also participated in an in-class discussion on conducting ethical social science fieldwork.

Before deploying the questionnaires, students shared them with campus stakeholders for feedback (see Acknowledgements). After incorporating the feedback, students roved across UGA's main campus in pairs for one

75-minute class period to administer the questionnaire. The questionnaire was distributed in hard copy and digital (QR code) formats (Qualtrics, 2020), allowing participants to choose their preferred response method. Students recruited participants by approaching individuals in high-traffic areas, such as the Tate Student Center and bus stops, using an open, cold-call approach.

Students manually input paper-based responses during the next class session, and the questionnaire remained open for 48 hours to allow for additional responses.

Data Analysis and Hazard Mitigation Strategy Development

Once the data collection period closed, students reviewed the initial dataset in class. The data were then cleaned and analyzed outside class time using Microsoft Excel (2018). Analyses included summary statistics and descriptive statistics. With preference in mind, each student was assigned to one of 15 hazards identified in the UGA Pre-Disaster Hazard Mitigation Plan (P-DHMP) based on their preferences (UGA OEP, 2018). Students used the survey results to create a mitigation strategy for each hazard, all requiring a title, written description, operational timeline, cost estimate, and funding source. The proposed mitigation strategies also had to support the existing UGA P-DHMP mitigation goal(s) to ensure their recommendations aligned with the university's mission.

At the end of the semester, students presented their proposals for hazard mitigation strategies at a 60-minute stakeholder summit held on campus during class time. The summit location and invitation list were selected through a class vote. Invited stakeholders included representatives from the UGA Office of Emergency Preparedness (OEP), the UGA Police Department, and the IDM. During the summit, each student presented two slides: one highlighting a specific hazard risk and another detailing a proposed mitigation solution. After the presentations, breakout discussions were held with campus stakeholders to evaluate the feasibility of the proposals and explore potential next steps.

Results

Emergency Alerts and Communications

Enrolling in emergency alert systems is a form of disaster preparedness because it enables individuals to receive timely communications during emergencies (National Academies of Sciences, Engineering, and Medicine [NASEM], 2018; Hu & Kapucu, 2016). As such, participants were asked about their enrollment status in the UGAAlert system and their preferred methods for receiving emergency alerts. Participants could select multiple responses, meaning the overall percentages presented are based on the total number of times each method was mentioned across all participants. Approximately 57% of participants reported subscribing to the UGAAlert system, 25% stated they were not enrolled, and 18% were unsure of their enrollment status. Most participants (90%) preferred receiving emergency alerts via text message, while some preferred emails (34%), phone calls (30%), or siren notifications (25%). Fewer participants preferred television broadcasts (11%) or radio alerts (9%).

To understand the social network of emergency communications, participants were asked where they would seek information in the event of a disaster. Most participants (41%) stated they would first seek information from UGA-related resources, such as UGAAlert, the SAFE application, the Police Department, the Tate Student Center, or the UGA OEP. Many would turn to local news outlets or social media platforms (26%), or online sources like Google and Reddit (17%). Some participants indicated they would consult individuals within their social network (17%), such as parents, friends, resident assistants, or emergency workers. A small percentage (3%) reported they would contact emergency services like 911 or consult the National Weather Service. Notably, 5% of participants were unsure where to seek information in a disaster, offering responses such as "I hadn't thought about it before" or "no clue."

Exposure to safety protocols on campus was limited. Only 36% of participants reported encountering safety protocols in course syllabi or work training, while 64% had not.

Emergency and Disaster Training

Completing emergency and disaster preparedness training is a common form of disaster preparedness, including at institutions of higher education (IHEs). Participants were asked whether they knew how to use or administer First Aid, cardiopulmonary resuscitation (CPR), Epi-Pens, Stop-the-Bleed kits, and automated external defibrillators (AEDs). Approximately 60% of participants knew how to use or administer First Aid, 38% wanted to learn, and 2% did not want to know. Similarly, 59% of participants knew how to use or administer CPR, 39% wanted to know, and 2% were uninterested. Fewer participants knew how to use an Epi-Pen (55%), Stop-the-Bleed kits (39%), or AEDs (31%), though interest in learning these skills was high, with more than half of participants expressing a desire to learn about Stop-the-Bleed kits (56%) and AEDs (59%).

Risk Perception and Preparedness

When asked which hazards could impact the campus, 49% of participants identified all listed hazards as potential risks. Specific hazards mentioned included active shootings or terror attacks (53%), cyberattacks (51%), and roadway collisions (47%). Infectious diseases (45%), extreme heat (45%), and severe wind (44%) were also noted. Participants were least concerned about dam failures (4%) and landslides (11%). Nearly 20% of participants stated they did not feel prepared for any listed hazards, while 14% felt prepared for all hazards. Hazards participants felt most prepared for included extreme heat (41%), lightning (40%), and extreme cold (37%), while they felt least prepared for cyber attacks (9%), hazardous material spills (4%), and dam failures (4%).

Participants were also asked about their confidence in UGA's ability to respond effectively to a disaster on campus. Approximately 60% of participants expressed confidence in UGA's disaster response capabilities, while 40% did not.

Accessibility and Mobility

Participants' living situations and modes of transportation were assessed to understand campus accessibility. Most participants (65%) lived in off-campus student housing, 20% commuted from non-student off-campus housing, and 14% lived in on-campus residence halls. Personal vehicles were the primary mode of transportation for 47% of participants, followed by walking (32%) and the campus bus system (16%). Fewer participants relied on bicycles, carpooling, or scooters (5%). Finally, 21% of participants identified as having access or functional needs, such as chronic conditions or injuries.

Discussion

Emergency Alerts and Communications

The findings highlight key areas of disaster preparedness at UGA and point to areas needing improvement. For example, encouraging greater enrollment in the UGAAlert system could enhance disaster preparedness by ensuring timely communication during emergencies. With only 57% of participants enrolled and 18% unsure of their status, there is a need to increase both awareness and participation. The preference for text message notifications among 90% of participants aligns with findings from Hu and Kapucu (2016) and highlights the importance of leveraging mobile platforms for emergency alerts. Additionally, the reliance on multiple sources for information, including UGA resources, social media, and personal networks, underscores the need for streamlined and reliable communication channels during crises (Austin et al., 2012; Sadri et al., 2017).

Participants' limited exposure to safety protocols (36%) in syllabi or campus training represents a missed opportunity to integrate preparedness into existing campus practices. Including safety information in syllabi and onboarding processes could normalize preparedness behaviors, foster a culture of readiness, and build resilience by offering disaster preparedness information to transient campus communities (Tanner & Doberstein, 2015).

Emergency and Disaster Training

Participants' strong interest in acquiring emergency response skills, such as Stop-the-Bleed and AED training, reflects a potential area for expanding disaster education initiatives. While many participants were familiar with

First Aid (60%) and CPR (59%), fewer had experience with AEDs (31%) or Stop-the-Bleed kits (39%). Expanding access to training opportunities through free or reduced-cost workshops could enhance disaster education through skills development, and aligns with Kapucu and Khosa's (2013) findings that disaster training is positively associated with resilience and preparedness at IHEs.

Risk Perception and Preparedness

Participants' perceptions of risk reveal both awareness and gaps in understanding. There is high concern for active shootings (53%), cyberattacks (51%), and roadway collisions (47%). However, the low awareness of risks such as dam failures (4%) and landslides (11%) suggests a need for broader hazard education, consistent with Sutton and Tierney's (2006) observation that underrepresented hazards are often overlooked in preparedness efforts.

Confidence in UGA's ability to respond to disasters was moderate, with 40% of participants expressing a lack of trust, an essential factor in institutional response capabilities critical for community resilience (Longstaff & Yang, 2008).

Accessibility and Mobility

The findings on accessibility and mobility emphasize additional challenges of disaster risk reduction on campus. The reliance on personal vehicles (47%) and the high percentage of commuters (85%) can point to potential logistical and operational issues during disasters (Godschalk, 2003). Further, 21% of participants had access and functional needs, highlighting the need to ensure that all campus community members are supported in disaster risk reduction efforts (Campbell, 2018; Kailes & Enders, 2007).

Recommendations

The findings of our study lead us to suggest seven primary actions to improve disaster reduction and preparedness at UGA:

1. Increase enrollment in the UGAAlert system (e.g., by conducting targeted outreach campaigns and integrating enrollment prompts into new student orientation materials).
2. Expand safety protocol integration (e.g., location of evacuation routes and tools) in syllabi, onboarding materials, and training programs.
3. Offer more free or subsidized training to address emergency skill gaps and increase campus resilience (e.g., CPR, First Aid, Stop-the-Bleed, and AED use).
4. Broaden hazard education efforts to include underrepresented risks like dam failures and landslides (e.g., by awareness campaigns).
5. Enhance transparency of, accessibility to, and communication about UGA's P-DHMP and other preparedness efforts (e.g., UGAAlert System) to build trust and engage with the campus community.
6. Invest in alternative transportation infrastructure to reduce the reliance on personal vehicles and improve mobility during emergencies (e.g., by improving bus services).
7. Enhance inclusivity in disaster planning by considering access and functional needs (e.g., by conducting focus groups or surveys to inform tailored support measures).

Limitations

Our study has several limitations. First, the recruitment strategy primarily targeted participants in and around the main campus (e.g., the Tate Student Center). While this yielded a substantial sample size, the sample population does not capture community members' experiences from other campus areas. Consequently, the findings represent a context-dependent snapshot rather than a comprehensive view of the entire campus population. Future studies should use more diverse recruitment methods (e.g., email invitations, digital distribution, or

satellite survey stations across multiple campus locations) over a more extended period of time to ensure broader geographic and demographic representation. Second, many participants refrained from completing the optional demographic questions in the questionnaire, limiting our ability to analyze responses by demographic variables. Future iterations of this study should require front-loaded demographic questions to encourage higher response rates.

Conclusions

In conclusion, our study examines the importance of fostering a culture of preparedness at IHEs like UGA. By examining the UGA community's risk perceptions and disaster preparedness, we identified existing strengths and areas for improvement on campus. The questionnaire results indicate a need for enhanced enrollment in emergency alert systems, more disaster preparedness education and training for students, faculty, and staff, and an increased awareness of campus hazards among the campus community, including visitors. Addressing the challenges of disaster risk education and outreach is an essential step in building confidence and trust in UGA's capability to prevent, plan for, respond to, and recover from disasters.

Further, engaging students in this research process has proven to be a powerful method for promoting campus disaster risk reduction and preparedness, underscoring the need to view disaster risk reduction education as a strategic priority for IHEs that benefits the whole campus community. The interdisciplinary approach and the collaboration with campus stakeholders further enriched the outcomes of this study, ensuring that the proposed mitigation strategies are theoretically sound, practical, and feasible.

As UGA continues to welcome tens of thousands of campus community members annually, the institution must prioritize disaster preparedness and risk reduction as central components of its operational strategy. By doing so, UGA can better protect its community, enhance campus safety, and serve as a disaster resilience model for other IHEs. Our study highlights that integrating comprehensive disaster risk reduction into campus culture is achievable and beneficial, providing a foundation for future research and action.

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Appendix

Questionnaire Questions

1. Are you subscribed to the UGA Alert system? *[multiple choice]*
 - a. Yes
 - b. No
 - c. I'm not sure
2. What is your preferred method of receiving emergency notifications and alerts? *[multi-select]*
 - a. Email
 - b. Phone call
 - c. Radio alert
 - d. Siren
 - e. Text message
 - f. Television broadcast
3. Which of the following do you know how to use or administer? If you do not know how to use or administer the following, would you like to learn? *[matrix]*
 - a. AED
 - b. CPR
 - c. Epi-Pen
 - d. First Aid
 - e. NARCAN Nasal Spray
 - f. Stop the Bleed
4. What hazards could potentially impact campus? *[multi-select]*
 - a. All of the hazards listed below could impact the campus
 - b. Active shooter or terror attack
 - c. Cyber attack (e.g., data breach)
 - d. Dam failure
 - e. Drought
 - f. Earthquake
 - g. Erosion
 - h. Extended loss of critical infrastructure (e.g., water, communications)
 - i. Extreme cold
 - j. Extreme heat
 - k. Fire or wildfire
 - l. Flood
 - m. Hail
 - n. Hazardous materials spill, leak, or explosion (e.g., ground or air contamination)
 - o. Hurricane
 - p. Infectious disease
 - q. Landslide
 - r. Lightning
 - s. Roadway collision (e.g., car vs. car, bicycle vs. pedestrian)
 - t. Severe wind
 - u. Severe winter weather
 - v. Tornado
 - w. None of the hazards listed above could impact the campus
5. Which of the following hazards do you feel prepared for? *[multi-select]*

-
- a. I feel prepared to respond to any of the hazards listed below
 - b. Active shooter or terror attack
 - c. Cyber attack (e.g., data breach)
 - d. Dam failure
 - e. Drought
 - f. Earthquake
 - g. Erosion
 - h. Extended loss of critical infrastructure (e.g., water, communications)
 - i. Extreme cold
 - j. Extreme heat
 - k. Fire or wildfire
 - l. Flood
 - m. Hail
 - n. Hazardous materials spill, leak, or explosion (e.g., ground or air contamination)
 - o. Hurricane
 - p. Infectious disease
 - q. Landslide
 - r. Lightning
 - s. Roadway collision (e.g., car vs. car, bicycle vs. pedestrian)
 - t. Severe wind
 - u. Severe winter weather
 - v. Tornado
 - w. I do not feel prepared to respond to any of the hazards listed above
6. In the event of a disaster on campus, where would you seek information? *[written answer]*
 7. Where do you feel is the most unsafe campus area, and why? *[written answer]*
 8. Were safety protocols ever included in your classes or campus work training? (For example, do any of your syllabi discuss what to do in the event of an emergency?) *[multiple choice]*
 - a. Yes
 - b. No
 9. Are you confident in UGA's ability to respond effectively to a disaster on campus? *[multiple choice]*
 - a. Yes
 - b. No
 10. What is your primary source of reliable transportation on campus? *[multiple choice]*
 - a. Personal vehicle
 - b. Carpool or rideshare
 - c. Bus system
 - d. Bicycle
 - e. Scooter
 - f. Walking
 11. What best describes your current living situation? *[multiple choice]*
 - a. Living in on-campus student housing (e.g., residence hall)
 - b. Living in off-campus student housing (e.g., apartment)
 - c. Commuting from other (non-student) off-campus housing
 12. Do you have access and functional needs (e.g., chronic conditions or injuries)? *[multiple choice]*
 - a. Yes
 - b. No

