

Online Teaching of Environmental Health

Abstract From the approach of our university, online teaching of environmental health is delivered through an asynchronous format using online teaching tools and a learning management system (LMS) such as Desire to Learn, Canvas, or Blackboard. Various sections within the LMS facilitate effective course delivery, including upload and download capability, a discussion forum, a course content platform, a quiz generator, audiovisual support tools, and grading templates. As part of an effective online classroom environment, we create a space for instructor–student communication as stipulated by the Association of College and University Educators and the American Council on Education to facilitate effective course delivery. This approach includes promoting learner-centered courses, a productive learning environment, active learning strategies, clear instructions, and fair and equitable assessments. In teaching environmental health online, we consider all the parameters outlined in the student course evaluation to ensure satisfaction with course delivery. Our five environmental health courses cover 1) occupational and environmental health science; 2) toxicology fundamentals; 3) industrial hygiene; 4) risk assessment, management, and communication; and 5) environmental health management. Last, we cover current environmental health topics and practical applications with consideration for federal and global health agencies such as the U.S. Environmental Protection Agency, Food and Drug Administration, and Federal Emergency Management Agency.

Keywords: asynchronous, course delivery, instructional design, environmental health, online teaching

Introduction

Online teaching became popular during the COVID-19 pandemic shutdown when millions of students across the globe had to rely on online (i.e., remote) learning (de Vries, 2021; DeCoito & Estaiteyeh, 2022). Two distinct modes of online teaching delivery exist: asynchronous and synchronous (DeCoito & Estaiteyeh, 2022; Martin et al., 2023). In an asynchronous format, students can participate in the course anytime and from anywhere. In a synchronous format, students participate in the course in real-time learning via virtual

meetings and discussions (Martin et al., 2023) and use videoconferencing platforms such as Zoom, which can be incorporated into a learning management system (LMS). Online courses are delivered via an LMS to create an interactive platform for student learning and content delivery. According to Forbes Advisor, the three top-rated LMSs that educators use are Desire to Learn (D2L) Brightspace, Canvas, and Blackboard (Haan, 2024).

Slippery Rock University and the University of Pittsburgh use D2L Brightspace and Canvas, respectively. Features that support

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student learning include Dropbox and modules with:

- File upload/download capabilities
- Grouping of students for assignments and projects
- Discussions with opportunities for student interaction
- Grading system with capabilities to provide specific and generic feedback via built-in rubrics
- Voice notes or annotation capabilities of submitted files
- Audiovisual tools such as VoiceThread, MediaSpace, and Zoom
- Plagiarism detectors
- Quiz generators

The Council on Education for Public Health (CEPH, 2023), a premier accrediting body for public health programs, lists 22 foundational competencies, 12 areas of foundational knowledge, and 5 concentration-level competencies. There is limited opportunity to meet the foundational competencies and knowledge in environmental health. A unique opportunity exists, however, to demonstrate environmental health competencies at the concentration level. In environmental

health, we cover the fundamentals of toxicology, industrial hygiene, environmental health management, risk assessment and communication, and occupational and environmental health science. We use teaching strategies outlined by the Association of College and University Educators (ACUE) to foster student engagement and participation. These strategies include learner-centered teaching, active learning, cooperative learning, inductive teaching and learning, clear instructions, and fair and equitable assessments.

To improve student learning, we incorporate a learner-centered teaching approach to enhance student learning through thought-provoking class activities that challenge their critical thinking (Wohlfarth et al., 2008). Learner-centered teaching focuses on the learner and amplifies their voices to create learning opportunities that better prepare students for the demands of the changing world and deeper learning (Bremner et al., 2022). Active learning involves participation in activities such as reading, writing, and discussion (Torrallba & Doo, 2020), which improve knowledge retention and provide an opportunity for a deeper understanding of the material (Wolff et al., 2015). Moreover, in an online class, discussion is an important component, creating an opportunity for students to interact in the virtual platform.

Cooperative learning, implemented through group projects, involves students working in small groups and helping each other in class activities (Slavin, 2014). Studies have shown that this approach creates a suitable learning environment for students, strengthens their skills (Keramati & Gillies, 2022), and facilitates students being more willing to contribute to class activities (Sugino, 2021).

Inductive teaching and learning involves methods such as inquiry learning, problem-based learning, project-based learning, case-based teaching, discovery learning, and just-in-time teaching, which in most instances have been found to be more effective than traditional teaching methods (Ktoridou, 2010; Prince & Felder, 2006). These methods are achieved via class assignments and discussions that incorporate real-world experiences into the class to challenge the students to think critically. With inductive teaching, it is important to ensure that instructions, including expectations for class activities, are clear throughout the syllabus.

In addition, a fair and equitable assessment of class activities is a priority and is achieved through a variety of techniques such as providing comprehensive rubrics, using blind grading features, and running plagiarism checks—all of which the three top-rated LMSs provide.

In this article, we describe some of the formats and components used for online teaching of environmental health and provide examples of some of the class activities used to meet the needs of our students and ensure the effectiveness of online education.

Instructional Design of Online Courses

To ensure students receive a quality online learning experience, we incorporate techniques into the courses with the assistance of course storyboarding. Storyboarding is a crucial step in instructional design for online courses, serving as a visual representation of the content, structure, and flow of the course. It is a planning tool that outlines the sequence of information, interactions, and assessments in a systematic and organized manner. The primary goal of storyboarding is to ensure the effective communication of instructional content and a seamless navigation for learners through the course material (Ertmer et al., 2013; Merrill, 2013; Morrison et al., 2019; Smith & Ragan, 2005).

Storyboarding includes the following key considerations:

- Visual representation: A series of panels or slides that represent different sections or modules of the online course. Each panel includes visuals, text descriptions, and indications of interactivity or multimedia elements.
- Content outline: A detailed outline that specifies the learning objectives, key concepts, and supporting information for each module or section. This outline helps instructional designers to maintain a clear focus on the learning goals.
- Navigation and interaction design: Navigation pathways within the online course indicate how learners will move from one section to another. Interaction elements (e.g., quizzes, discussions, multimedia presentations) are also planned.
- Media integration: Visual and multimedia elements (e.g., images, videos, audio clips, interactive simulations) are incorporated

to ensure a balanced and engaging online learning experience.

- Assessment strategies: Assessment methods and activities (e.g., quizzes, assignments, discussions, other forms of evaluation to measure learner understanding and retention) are detailed within the course.
- User interface design: User interface and overall design aesthetics are detailed in wireframes or mock-ups of the online course interface to ensure a user-friendly and visually appealing learning environment.
- Feedback and iteration: Early feedback is sought from subject matter experts, other members of the instructional design team, and any involved parties in an iterative process that helps refine the course design before development begins.

Announcements

At the beginning of each week or selected period, an announcement is posted to the students outlining expectations, due dates, and suggestions for a better class outcome. In addition to these announcements, the LMS has a calendar section to remind students of due dates and tasks. It is imperative that students in an online class get a summary of the week's lesson. This announcement minimizes questions from the students that affect faculty time.

Clarity of courses is crucial for an online class to help reduce the pressure of not being physically on campus. Online courses provide a unique flexibility that fits into students' schedules, allowing them to enroll in classes without geographical limitations. Furthermore, it allows many employed students the flexibility to complete their coursework around their work schedules. Last, the LMS can send direct emails to enrolled students. The following is an example of a weekly announcement:

Expectations/assignments for the week:

1. Participate in and complete the discussion.
2. Remember that Chapter 50 will be part of the multiple-choice exam.
3. Your discussion is due on [date], at 11:59 p.m. (Your initial response is due on [day, date, time].)

Syllabi

The use of a comprehensive syllabus cannot be overemphasized. Essential components of a syllabus include class information such as course title, course number, instructor

contact information, office hours, course learning objectives, program outcomes, university outcomes, and CEPH competencies and foundational knowledge. The syllabus also includes grading rubrics for assignments, discussions, exams, and projects, along with class schedules and additional mandated university information such as academic integrity, Title IX, Office of Disability, and misconduct policies (Table 1). Referring to the syllabus in every assignment and class activity is essential to reinforce students' commitment to the class. In the syllabus, an effort is made to demonstrate the interrelationships among the course outcome, course competencies, and program outcome. The syllabus has assessments to meet CEPH foundational and concentration competencies and public health foundational knowledge. CEPH evaluates all syllabi in their accreditation reviews.

In addition to being a learning tool, a syllabus serves as a permanent record and a point of contact between the students and the instructor (Parkes & Harris, 2002; Wheeler et al., 2019). The syllabus sets the tone for the class and outlines the course, expectations, communication strategies, and the relationship between covered topics and the course curriculum (Wagner et al., 2023). It is important to consider student perception of a syllabus by addressing factors such as the power balance between the instructor and students, style of learning objectives, framing of assignments, and the design of the syllabus being graphic-rich versus text-rich (Wheeler et al., 2019). Following training and certification with ACUE, our environmental health course syllabus is aligned with learner-centered (i.e., less content-centered) syllabi (Table 1).

Discussion Forum

An online discussion forum is essential to encourage participation among the students and between students and the instructor, as an online platform can foster interactions that are similar to ones present in a face-to-face class. There is a consensus that mandatory discussion positively influences learning (Du et al., 2022). A discussion forum enables students to comment on one another's posts, and instructors can provide feedback on these posts. As part of the instruction, students cannot respond to other students without first having an initial

TABLE 1

Categories and Contents of a Sample Environmental Health Syllabus

Category	Content
Course identity	University, department, course registration number, and offering semester
Instructor information	Name, Zoom information, office hours, office address, office phone number, email address, and meeting scheduling information
Course information	Course structure and course delivery
Course learning outcome	Course-specific outcome after successful completion of the class
Textbook information	Required textbook and materials, with other optional reading materials
Council on Education for Public Health competencies	Foundational competencies, foundational knowledge, and concentration competencies
University and program outcomes	Program outcome and university outcome
Learning outcome overlap	Overlap between course learning outcome and 1) program learning outcome, 2) university learning outcome, and 3) environmental and occupational health concentration competencies
Assessment	Grading system and scale, grading rubrics, assignments, discussions, paper projects, and multiple-choice exams
University requirements	Title IX, students with special needs, nondiscrimination, academic integrity, identified pronouns and names, inclusion, and online course etiquette
Course schedule	Weekly activities, discussions, assignments, paper projects, reading materials, holidays and breaks, exams, and due dates

position. This creates an atmosphere that can mimic interactions in an in-person class. Some classes require that students ask questions of their classmates' discussion posts. In turn, the original poster must respond to their classmates' questions. This approach is an ideal way to elicit a back-and-forth discussion among the students.

Assignment and Group Projects

The Dropbox feature in D2L and modules in Canvas and Blackboard are used to post assignments and provide an opportunity for group work. Students can be assigned to groups individually or randomly, and there is an option for students to choose a group. These LMSs also have a feature to check for plagiarism using Turnitin. Group assignments create an opportunity for student collaborations even though students are in different physical locations. Zoom communication is linked to the LMS to further facilitate student collaboration. Students have several options to submit assignments, including document attachments, file uploads, audio recordings, and video recordings.

Course Overviews

Occupational and Environmental Health Science

CEPH requires core courses in environmental and occupational health regardless of a student's concentration. The courses at Slippery Rock University and the University of Pittsburgh have embedded components that emphasize environmental justice across disparate populations. The course covers sources; exposure pathways; routes; and the health impacts of chemicals, agents, and pathogens. Introduction to risk assessment, regulatory consideration, and the importance of culturally sensitive risk communication are also covered. This information fulfills the CEPH (2023) foundational competency 18 (Select communication strategies for different audiences and sectors) and 20 (Describe the importance of cultural competence in communicating public health content).

Sample Paper Project

In 2014, residents of Flint, Michigan, were exposed to drinking water that contained

lead concentrations above the acceptable limit. Write a paper on the events in Flint regarding lead exposure. Address and discuss the following:

- Cause of lead exposure in Flint
- Other sources of lead exposure in children and adults
- Routes of exposure, body accumulation, and health impacts of lead
- Populations vulnerable to lead exposure in Flint and in general
- Current acceptable blood and water lead levels (add some historical perspective on how we got to these levels)
- Outcome of any investigation regarding lead exposure in Flint
- Implications of leaded gasoline (and why it was phased out)
- Role of socioeconomic status on lead exposure in the U.S.
- Various lead abatement strategies
- Risk assessment for lead exposure, including risk management and communication
- How events in Flint are connected to what happened or is happening in any local community of your choice regarding lead exposure
- Lead-related policies in our state (Pennsylvania)

Toxicology Fundamentals

This course teaches students the fundamentals of toxicology and covers topics such as exposure routes of hazards, point and non-point sources of contaminants, toxicokinetics and toxicodynamics of xenobiotics, determination of exposure limits of chemicals, regulatory toxicology, and the role of toxicity testing/toxicological reports by government agencies.

Sample Discussions

Discuss the bioaccumulation of mercury and its health impacts on humans. Discuss and explain:

- The concept of bioaccumulation
- Bioaccumulation of mercury
- Health impacts of mercury
- Historical perspective on the health impacts of mercury

Discuss the factors that affect the dose-response relationship of a chemical. Include:

- Concept of a dose-response relationship
- Define hormesis and its relevance in toxicology

- Give four examples of a dose-response relationship

Industrial Hygiene

These courses provide the students with the fundamentals of industrial hygiene, including topics such as exposure monitoring of hazards; regulation of exposure and monitoring; exposure limits; industrial toxicology; understanding of sampling of hazards and devices; state and federal laws on exposure to hazards; sampling media; exposure limits; ventilation and workplace safety; radiation, dermal, and noise exposure in the workplace; communication of sampling and monitoring; ergonomics; result interpretation; thermal stress; worker protection; and control of contaminants.

Sample Assignment

Describe in detail the components of the basic local exhaust system and its role in protecting workers from hazards. Describe:

- All the components of the basic local exhaust system
- How these components help to protect workers from hazards
- Components that are more critical for worker safety and why

Risk Assessment, Management, and Communication

These courses give students information on the steps of risk assessment, the role of government agencies in managing risk, and the importance of communicating risk to different audiences. Topics include risk assessment, the risk assessment–risk management paradigm, regulatory decision-making, measurement of exposure and application to risk assessment, monitoring of exposure throughout life stages, the role of epidemiology in environmental health research, the application of physiologically based pharmacokinetic (PBPK) modeling to risk assessment, adverse outcome pathways, epigenetics in risk assessment, characterization of aggregate and cumulative risk, occupational risk assessment, childhood environmental health risk assessment, safer alternative risk assessment for environmental health, and risk communication.

Sample Paper Project

The train derailment in East Palestine, Ohio, released chemicals into the environment, potentially exposing residents. One of the

chemicals released was vinyl chloride. As a future environmental health official, describe the risk assessment process for vinyl chloride in the context of a train derailment.

Address the following based on information from a similar process by a government agency of your choice:

- Agency you selected
- Any historical perspective on vinyl chloride
- Hazard identification
- Dose-response assessment
- Exposure assessment
- Risk characterization, including any biomarkers associated with exposure
- Risk management
- Risk communication
- Evaluation of the risk assessment process
- Any laws guiding the risk assessment
- Any personal suggestions to improve the risk assessment process

Environmental Health Management

This course embraces the role of leadership, teamwork, and systems thinking in addressing environmental and occupational health issues. The course emphasizes the impact of leadership style by using government and nongovernmental agencies to drive effective management resources to solve environmental and occupational health issues. This course discusses the role of communities in conjunction with agencies in implementing environmental and occupational health plans. Some of the topics covered include public health preparedness; threats from biological, chemical, nuclear, and radiological weapons; naturally occurring diseases and disasters; the impact of 9/11; legislation, regulation, and policies; biosecurity; surveillance and attribution investigation; the preparedness cycle; public health emergency operation centers; exercises; and capacity building.

Sample Discussion

Discuss the strategic implications of global health from a management point of view using the COVID-19 pandemic as a case study.

Course Resources

For our online class, we use resources from the U.S. Environmental Protection Agency (U.S. EPA), Food and Drug Administration (FDA), Federal Emergency Management Agency (FEMA), National Institute for Occupational Safety and Health (NIOSH),

Occupational Safety and Health Administration (OSHA), Centers for Disease Control and Prevention (CDC), World Health Organization (WHO), United Nations (UN), and Organisation for Economic Co-operation and Development (OECD).

Some of the textbooks used for our environmental health classes include:

- *Essentials of Environmental Health*, 3rd ed., 2018, Jones & Bartlett Learning.
- *Essentials of Industrial Hygiene*, 1st ed., 2015, National Safety Council.
- *Essentials of Public Health Preparedness and Emergency Management*, 2nd ed., 2018, Jones & Bartlett Learning.
- *Principles and Practice of Toxicology in Public Health*, 2nd ed., 2013, Jones & Bartlett Learning.
- *Risk Assessment for Environmental Health*, 2nd ed., 2023, CRC Press.

Discussion and Conclusion

Our online teaching of environmental health embraces strategies recommended by ACUE for effective teaching. Using LMS platforms such as D2L, Canvas, and Blackboard provides students with a virtual environment that enhances their depth of learning and creates a space to optimize varied levels of interaction among students. We accomplish these strategies via the features embedded in an LMS. Discussion forums create a platform for student interaction and an opportunity for peer-to-peer and student-faculty feedback. In support of the need for more interaction, the ability to upload and download content in the LMS creates opportunities for student collaboration on group projects.

We use learner-centered syllabi to provide an online experience where we put students

first and meet the environmental health outcomes that are based on accreditation and institutional standards. We leverage the LMS technology to provide students with the resources and flexibility of asynchronous online education and to facilitate student-faculty interactions. Lastly, continuous efforts are in place to improve the student online experience and address concerns raised by students in course evaluations. 🌸

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References

- Bremner, N., Sakata, N., & Cameron, L. (2022). The outcomes of learner-centred pedagogy: A systematic review. *International Journal of Educational Development*, 94, Article 102649. <https://doi.org/10.1016/j.ijedudev.2022.102649>
- Council on Education for Public Health. (2023). *Accreditation criteria: Schools of public health & public health programs*. <https://media.ceph.org/documents/2021.Criteria.pdf>
- de Vries, T.J. (2021). The pandemic that has forced teachers to go online: Zooming in on tips for online teaching. *Frontiers in Education*, 6. <https://doi.org/10.3389/educ.2021.647445>
- DeCoito, I., & Estaiteyeh, M. (2022). Online teaching during the COVID-19 pandemic: Exploring science/STEM teachers' curriculum and assessment practices in Canada. *Disciplinary and Interdisciplinary Science Education Research*, 4(1), Article 8. <https://doi.org/10.1186/s43031-022-00048-z>
- Du, Z., Wang, F., Wang, S., & Xiao, X. (2022). Enhancing learner participation in online discussion forums in massive open online courses: The role of mandatory participation. *Frontiers in Psychology*, 13, Article 819640. <https://doi.org/10.3389/fpsyg.2022.819640>
- Ertmer, P.A., Quinn, J.A., & Glazewski, K.D. (2013). *The ID casebook: Case studies in instructional design* (4th ed.). Pearson.
- Haan, K. (2024). *Best learning management systems (LMS)*. Forbes Advisor. <https://www.forbes.com/advisor/business/best-learning-management-systems/>
- Keramati, M.R., & Gillies, R.M. (2022). Teaching cooperative learning through cooperative learning environment: A qualitative follow-up of an experimental study. *Interactive Learning Environments*, 32(3), 879–891. <https://doi.org/10.1080/10494820.2022.2100429>
- Ktoridou, D. (2010). *Applying an inductive method to a new, multidisciplinary, management of innovation & technology course: Evidence from the University of Nicosia* (pp. 1805–1809). IEEE EDUCON 2010 Conference, Madrid, Spain.
- Martin, F., Kumar, S., Ritzhaupt, A.D., & Polly, D. (2023). Bichronous online learning: Award-winning online instructor practices of blending asynchronous and synchronous online modalities. *The Internet and Higher Education*, 56, Article 100879. <https://doi.org/10.1016/j.iheduc.2022.100879>
- Merrill, M.D. (2013). *First principles of instruction: Identifying and designing effective, efficient, and engaging instruction*. Pfeiffer.
- Morrison, G.R., Ross, S.J., Morrison, J.R., & Kalman, H.K. (2019). *Designing effective instruction* (8th ed.). John Wiley & Sons.
- Parkes, J., & Harris, M.B. (2002). The purposes of a syllabus. *College Teaching*, 50(2), 55–61. <https://doi.org/10.1080/87567550209595875>
- Prince, M.J., & Felder, R.M. (2006). Inductive teaching and learning methods: Definitions, comparisons, and research bases. *Journal of Engineering Education*, 95(2), 123–138. <https://doi.org/10.1002/j.2168-9830.2006.tb00884.x>
- Slavin, R.E. (2014). Cooperative learning and academic achievement: Why does groupwork work? *Annals of Psychology*, 30(3), 785–791. <https://doi.org/10.6018/analesps.30.3.201201>
- Smith, P.L., & Ragan, T.J. (2005). *Instructional design* (3rd ed.). J. Wiley & Sons.
- Sugino, C. (2021). Student perceptions of a synchronous online cooperative learning course in a Japanese women's university during the COVID-19 pandemic. *Education Sciences*, 11(5), Article 231. <https://doi.org/10.3390/educsci11050231>

References

- Torralba, K.D., & Doo, L. (2020). Active learning strategies to improve progression from knowledge to action. *Rheumatic Disease Clinics of North America*, 46(1), 1–19. <https://doi.org/10.1016/j.rdc.2019.09.001>
- Wagner, J.L., Smith, K.J., Johnson, C., Hilaire, M.L., & Medina, M.S. (2023). Best practices in syllabus design. *American Journal of Pharmaceutical Education*, 87(3), Article ajpe8995. <https://doi.org/10.5688/ajpe8995>
- Wheeler, L.B., Palmer, M.S., & Aneece, I. (2019). Students' perceptions of course syllabi: The role of syllabi in motivating students. *International Journal for the Scholarship of Teaching and Learning*, 13(3), Article 7. <https://doi.org/10.20429/ijstl.2019.130307>
- Wohlfarth, D., Sheras, D., Bennett, J.L., Simon, B., Pimentel, J.H., & Gabel, L.E. (2008). Student perceptions of learner-centered teaching. *InSight*, 3(1), 67–74. <https://doi.org/10.46504/03200808wo>
- Wolff, M., Wagner, M.J., Poznanski, S., Schiller, J., & Santen, S. (2015). Not another boring lecture: Engaging learners with active learning techniques. *The Journal of Emergency Medicine*, 48(1), 85–93. <https://doi.org/10.1016/j.jemermed.2014.09.010>

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