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Preparing future-ready public health professionals: a blended, AI-integrated pedagogical innovation

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Abstract

Introduction In the evolving landscape of higher education, especially in public health, innovative pedagogical approaches are essential to promote deeper learning and real-world readiness. This study explored a blended, mixed-method teaching intervention combining generative AI, field exposure, expert interaction, and student-led presentations to teach occupational health to postgraduate public health students in India.

Methods A group of 22 Master's in Public Health students participated in a structured learning sequence including classroom lectures, an industrial site visit, interaction with an occupational health expert, and hands-on use of ChatGPT to explore occupational hazards and prevention strategies. Students worked in groups to generate structured outputs, critically analysed AI-generated content, and presented findings. Faculty facilitated the session and reinforced key concepts. Student feedback was collected using a semi-structured questionnaire comprising Likert-scale and open-ended questions.

Results Quantitative analysis revealed high engagement (mean = 4.3), improved ability to structure content (mean = 4.7), and appreciation for AI's role in learning (mean = 4.1). Students also reported increased confidence in critically evaluating AI-generated information. Thematic analysis of qualitative responses highlighted usefulness, practical relevance, enhanced interaction, and the value of field exposure as key strengths. It also revealed, areas for improvement, such as time management and AI training.

Conclusion This blended, student-centred model combining experiential learning and generative AI proved effective in promoting engagement, critical thinking, and digital literacy. The approach offers a replicable framework for pedagogical innovation in health sciences education.

Keywords Blended learning, Experiential learning, Generative artificial intelligence, Occupational health, Public health pedagogy, Student-centred learning

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Introduction

Higher education is undergoing a transformative shift from traditional passive instruction to learner-centred methodologies that encourage students to construct knowledge actively rather than receive it passively. This evolution is especially significant in health and medical education, where applied knowledge, critical thinking, and digital fluency are essential to navigate complex, real-world challenges [1, 2]. Within this evolving context, blended learning has emerged as a powerful pedagogical approach, integrating digital tools with experiential strategies such as industrial visits and expert interactions to deepen student engagement, flexibility, and autonomy [3, 4].

Blended learning facilitates cognitive engagement by linking theoretical content with authentic, real-world exposure. Through activities like field visits and simulations, students are able to internalize information more effectively and develop professional competencies such as teamwork, ethical reasoning, and critical thinking [5–7]. In this context, the educator transitions from a content deliverer to a learning facilitator, enabling reflective, interdisciplinary engagement [8].

Parallel to these pedagogical developments is the integration of generative Artificial Intelligence (AI) tools such as ChatGPT in higher education. These tools have revolutionized how students access, process, and synthesize information. When used ethically and critically, generative AI supports assignment writing, summarizing complex materials, and fostering active learning [9, 10]. However, it also necessitates a rethinking of teaching strategies to ensure students can appraise, critique, and validate AI-generated information, thereby aligning with the core principles of digital literacy and academic integrity [11–13].

To harness the benefits of AI, particularly in health education, it is essential to adopt pedagogical frameworks that blend AI-generated content with grounded, experiential learning. Such integrated approaches promote critical evaluation, contextual understanding, and self-directed learning. This is particularly relevant in public health and occupational health education, where theoretical frameworks must be matched with field-based realities such as workplace hazards and disease prevention strategies [14, 15].

Generative AI, when paired with experiential methods such as industrial visits and expert discussions, enables students to validate AI outputs through real-world context. This blended, mixed-methods pedagogy fosters deeper understanding and a sense of ownership over learning, aligning with Bloom's higher-order cognitive domains analysis, synthesis, and evaluation [16]. Moreover, it supports essential competencies such as digital literacy, evidence-based reasoning, and collaborative problem-solving [17, 18].

Studies have shown that integrating AI into blended learning environments enhances student motivation, supports active learning, and improves educational outcomes, especially in applied disciplines [19, 20]. In occupational health education, AI tools can bridge the gap between textbook content and workplace complexity by enabling students to explore scenarios, identify risks, and develop preventive strategies [21, 22].

The present study explores a pedagogical intervention that combines generative AI and experiential learning in the teaching of occupational health. Following industrial visits and expert interactions, students engaged with ChatGPT to explore industry-specific hazards and prevention strategies, generating structured outputs while verifying sources and citations. The study evaluates this blended learning model's impact on student engagement, knowledge retention, digital skill acquisition, and perceived relevance to real-world public health challenges. Thus, this integrated approach not only supports the development of AI literacy but also reinforces applied knowledge and reflective thinking key competencies for future-ready public health professionals.

Methodology

Study context

The Occupational Health module is a required course in the second semester of the two-year Master of Public Health (MPH) program at our institution. Spanning a semester with 45 contact hours, this module is structured to provide students with both theoretical understanding and real-world insights into workplace health and safety.

It begins with sessions covering key topics such as industrial classification, common occupational hazards and diseases, and legal frameworks for prevention and control. To bridge theory with practice, students participate in an industrial site visit to a petrochemical facility, where they observe workplace processes, risk mitigation strategies, and engage in discussion with occupational health specialists. Following this field exposure, students joined group workshops that introduce them to generative AI tools, specifically ChatGPT, to help them organize, analyse, and present information about occupational hazards and preventive strategies. These sessions emphasize evidence-based reasoning, critical appraisal of AI-generated information, and the practical use of digital skills. This blended approach supports key MPH program outcomes by fostering skills in evidence evaluation, interdisciplinary teamwork, and digital literacy. Importantly, the design aligns with current recommendations in public health education, which advocate for integrating technology and experiential activities to better prepare graduates for the complexities of modern health systems [23–25].

This educational intervention was implemented within the Occupational Health module for students pursuing a Master's in Public Health at a public health institution in India. The intervention aimed to enhance experiential and collaborative learning using a blended pedagogical approach combining field-based exposure and generative AI model gpt-4-0125.

Study design

The study comprised responses from 22 Master of Public Health students enrolled in the Occupational Health module. Feedback was collected using a pre-tested, semi-structured Google Form that included both Likert-scale (1–5) and open-ended questions. Quantitative analysis involved calculation of means and standard deviations for each statement. Qualitative analysis followed the six-step thematic analysis process by Braun and Clarke (2006) [26]. Two authors independently coded the data, compared themes collaboratively, and finalized codes through discussion. Quotes are attributed anonymously (e.g., Student 1, Student 2) to enhance credibility.

A mixed-methods, exploratory pedagogical framework was adopted. The Kolb's Experiential Learning Theory (ELT) [6] and the SAMR (Substitution, Augmentation, Modification and Redefinition) instructional design and model [27] respectively were adopted for technology integration in occupational health education (Fig. 1). This intervention comprised six key phases:

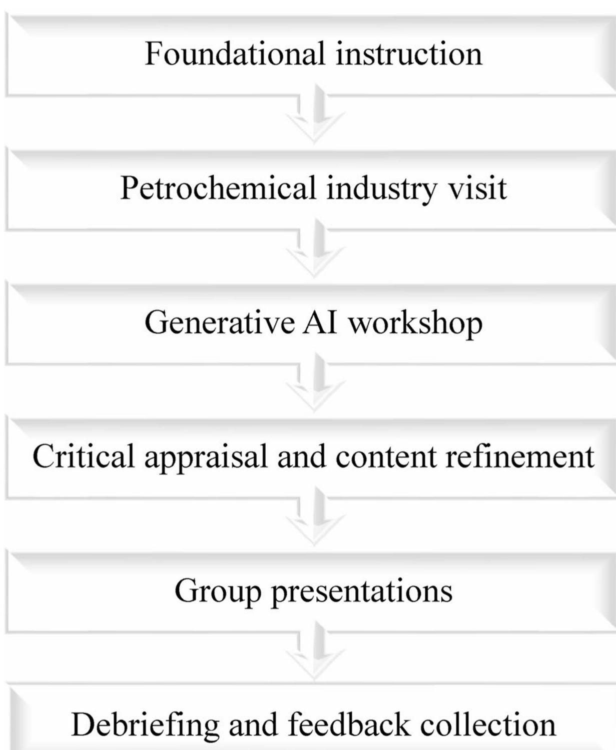

Fig. 1 Framework of blended pedagogical approach in public health education in alignment with Kolb's Experiential Learning Theory (ELT) [6], Substitution (Augmentation of Redefinition) SAMR Model and Constructivist Learning Theory [27]

1. *Foundational Instruction*:

   This intervention initiated with a structured didactic session to introduce core concepts of occupational health. Topics included industrial classification; common occupational hazards (chemical, physical, biological, mechanical and psychosocial), associated disease conditions, and strategies for prevention (engineering controls, administrative measures, personal protective equipment, and legal frameworks).

2. The exposure visit to a petrochemical industry: Students participated in an exposure visit to a petrochemical industry in Vadodara. This experience was grounded in situated learning theory. They toured the permissible operational areas and the Occupational Health Centre, followed by an interactive session with the industry's occupational medical officer. The session included detailed discussions on workplace exposures, risk mitigation protocols, and occupational health surveillance, including baseline and periodic medical examinations. The objective of the visit was to provide experiential context to theoretical knowledge.
3. Generative AI Workshop:

   Following the field visit, students were taught the educational applications of generative AI, focusing on responsible and critical use. Students, equipped with laptops and internet access, were divided into four heterogeneous groups (5–7 members each) and provided with both a common context-setting prompt and group-specific tasks related to different occupational settings. Prompts required students to generate comparative tables of hazards, exposures, diseases, prevalence, and preventive strategies for:

   1. *Foundry and construction industries.*
   2. *Agricultural and food sectors.*
   3. *Occupational cancers, lung diseases, and toxic exposures.*
   4. *Psychological hazards and ergonomic issues.*

A final prompt emphasized citation accuracy and use of APA referencing to explain the importance of citations in academic content.

4. *Critical Appraisal and Content Refinement*: Students were then taught to critically review AI-generated outputs using a structured checklist. Faculty guided students in validating information sources, identifying omissions, and enriching content with additional literature, images, and diagrams to enhance comprehension and presentation quality.
5. *Group Presentations and Expert Feedback*: In next session, each group presented their synthesized findings in class. Faculty provided constructive feedback and supplemented content with domain-specific insights. For example, lung conditions like Byssinosis and Bagassosis specific to cotton and sugarcane workers respectively were discussed in detail when found missing in AI-generated responses.
6. *Debriefing and Feedback Collection*: A debriefing session encouraged reflective dialogue between faculty and students. Apart from this, feedback was systematically collected using a semi-structured Google Form that included both quantitative (Likert-scale) and qualitative (open-ended) items to evaluate the intervention's effectiveness and usability of AI tools.

Framework Alignment: This intervention aligns with.

- *Kolb's Experiential Learning Cycle* (Concrete Experience, Reflective Observation, Abstract Conceptualization, Active Experimentation).
- *SAMR Model* for educational technology use.
- *Constructivist Learning Theory*, emphasizing learner agency and contextual knowledge construction.

Data collection
Feedback was gathered using pre-tested and validated a semi-structured Google Form, comprising Likert-scale (1–5) and open-ended qualitative questions.

Quantitative analysis
Average, standard deviation and 95% confidence interval of the Likert-scale (1–5) for the responses by the students was calculated.

Qualitative analysis
Feedback was analysed thematically across five domains: usefulness, engagement, relevance, effectiveness, and areas for improvement. Additionally, we defined the thematic result in form of deductive vs. inductive coding.

For the analysis of students' written feedback, we applied thematic analysis using the six-step process described by Braun and Clarke (2006) [26], a standard and widely recognized approach for analysing qualitative data in educational research. The authors independently read all student comments several times to become familiar with the content. Next, they each identified and highlighted key points or ideas mentioned by students (called "coding").

The authors then met to compare their initial codes and discussed similarities and differences to develop broader themes that captured the main patterns in the data, such as usefulness, engagement, and areas for improvement. Through several rounds of discussion, we refined these themes together until both agreed on their final definitions and content. This collaborative and iterative process reduced any individual bias and supported a more trustworthy analysis. This approach follows best practices for qualitative research and enhances the credibility of the study's findings [26].

Results

Quantitative analysis
Feedback was received from 22 Master of Public Health students using a semi-structured Google Form. The questionnaire comprised Likert scale questions (1 to 5, with 5 as the highest score) assessing the usefulness, engagement, relevance, and effectiveness of the AI-assisted teaching session.

Table 1 illustrates the quantitative feedback on usefulness of exercise and learning using generative AI skills. Amongst all feedback received it was found that the activity notably improved the students' ability to structure information clearly in a comprehensive tabular form.

Standard deviations ranged from 0.7 to 1 across the items, suggesting moderate agreement among students. All 22 students responded to each item, and no missing data were recorded.

Qualitative feedback themes
To get a better understanding of the students' perceptions of this blended pedagogical approach, qualitative feedback was analysed thematically across five key domains: *Usefulness*, *Engagement*, *Relevance*, *Effectiveness, and Areas for Improvement.* The feedback reflects student experiences throughout the structured learning sequence beginning with a theoretical overview, followed by an industrial visit and expert interaction, guided exploration using generative AI, critical evaluation of AI outputs, and culminating in group presentations with expert faculty input. This sequence of events encouraged reflective learning, fostered technological fluency, and bridged classroom theory with real-world occupational health contexts. The reflections shared by the students are analysed under the following themes:

1. Usefulness of the Learning Experience:

Table 1 Quantitative feedback of the students on usefulness of exercise and learning using generative AI skills ($n=22$)

Statement of feedback	Mean	95% CI	Standard Deviation (±)
Usefulness of Exercise			
I found this AI-based activity engaging.	4.32	(3.88, 4.76)	0.99
I understood occupational health concepts better through this activity.	4.27	(3.86, 4.69)	0.94
This exercise improved my ability to extract and structure information.	4.14	(3.68, 4.6)	1.04
I found Generative AI helpful for preparing evidence-based content.	3.95	(3.47, 4.44)	1.09
The activity improved my ability to structure information clearly in a table or summary format.	4.73	(4.48, 4.97)	0.55
Leaning using Generative AI Skills			
I now better appreciate how generative AI can be used in public health education.	4.18	(3.72, 4.65)	1.05
I learned how to write clear and specific prompts to get better results from Generative AI	4.36	(4.04, 4.69)	0.73
I understood the limitations of Generative AI and the need to verify the information it provides	4.32	(3.95, 4.69)	0.84
I found the discussion on checking the authenticity of Generative AI's references and data useful.	4.09	(3.66, 4.52)	0.97
I am now more confident in refining Generative AI generated content for academic or presentation purposes.	4.27	(3.86, 4.69)	0.94
I can now critically evaluate AI-generated content.	4.18	(3.78, 4.58)	0.91
This exercise has motivated me to explore generative AI tools further for academic use.	4.09	(3.64, 4.54)	1.02
I am likely to use AI tools like Generative AI as a supplementary aid in learning.	4.14	(3.66, 4.62)	1.08

Students expressed that the integration of generative AI tools with hands-on exposure and guided analysis improved their learning significantly. The structured tabular outputs generated by ChatGPT allowed them to comprehend complex occupational health concepts efficiently in simplified manner.

> *"This approach helped me understand the topic faster. Seeing the hazards and diseases organized in the tabular form made it easy to remember." (Student, age: 24 yrs, MPH).*
> *"AI helped me simplify and understand the various workplace health risks. It was like getting a personal teacher teaching me based on my requirement." (Student, age: 22 yrs, MPH).*
> *"The whole experience starting from the industrial visit to using AI gave me a 360 degree understanding of the subject." (Student, age: 24 yrs, MPH).*

2. Engagement and Student Involvement.

The blended design encouraged students to participate actively, whether it is real-time prompt writing, evaluating responses, or presenting their findings. They appreciated the shift from passive listening to active learning.

> *"It was exciting to be part of the whole process right from generate prompts to presenting what we discovered. I felt like I was truly involved throughout the exercise." (Student, age: 23 yrs, MPH).*
> *"Working in a group to evaluate AI results sparked good discussions. Everyone in our team contributed, and we learnt from each other." (Student, age: 23 yrs, MPH).*
> *"I have never had a class where I could use technology this interactively. It was fun and made the topic more relatable." (Student, age: 24 yrs, MPH).*

3. Relevance to Occupational Health.

Students emphasized that the experience allowed them to connect textbook knowledge with real-world observations, especially through the industrial visit and AI-assisted data synthesis.

> *"Visiting the petrochemical factory helped me see things first-hand, and using ChatGPT later helped make sense of what I observed and learnt with expert interaction." (Student, age: 22 yrs, MPH).*
> *"It was very relevant to occupational health. The AI gave us detailed responses that matched what the expert had explained during the factory visit." (Student, age: 22 yrs, MPH).*
> *"Combining learnings from the field visit with AI learning made the subject more meaningful and practical." (Student, age: 25 yrs, MPH).*

4. Effectiveness of the Pedagogical Design.

Participants highlighted how this blended teaching model improved their technical abilities especially in structuring content, checking citation credibility, and refining academic communication. They also felt more confident using AI tools for academic purposes.

> *"We learned how to evaluate the responses generated by AI rather than just accept them." (Student, age: 22 yrs, MPH).*
> *"I learnt writing better prompts from this exercise and evaluate if the AI generated responses is use-*

ful or needed improvement." (Student, age: 21 yrs, MPH).
"So far I used to think that AI generated content could not be trusted, but now I know how to validate and strengthen it with appropriate references." (Student, age: 22 yrs, MPH).

5. Challenges and Opportunities for Improvement.

Despite overall positive experiences, students identified certain challenges, such as limited time for preparation and the need for prior AI tool exposure.

"We could have provided more time to prepare our presentations and finalize it." (Student, age: 21 yrs, MPH).
"It would be helpful if we could get hands on experience of learning using ChatGPT during future assignments." (Student, age: 22 yrs, MPH).
"Some of the AI generated responses felt generic. Learning prompts to generate more specific response will be helpful." (Student, age: 23 yrs, MPH).

Discussion

The shift toward more dynamic and student-centred models of education has become a defining feature of modern-day pedagogy, especially in the field of Public Health, which demands applied knowledge. This study highlights the value of using a blended learning model that integrates field-based exposure with digital tools like generative AI to provide a more holistic and engaging learning experience for students learning occupational health.

By integrating industrial visits with structured AI-generated learning and critical evaluation exercises, the students were exposed to the active process of learning, analysis, and synthesis. The blended design empowered them not just to consume information, but to engage with it by posing questions, validating sources, and contextualizing their findings with real-world occupational health settings [26]. The industrial visit component was impactful in grounding abstract concepts in lived experience and has enhanced the interpretability of AI-generated data [28]. Such experiential exposure helped students visualize industrial processes, associated hazards, and formulate prevention strategies beyond textbook narratives [29].

The integration of generative AI in the study added another layer of depth. Instead of replacing traditional teaching, AI was positioned as a tool that catalysed critical thinking and fostered in developing structured communication. Students learned to craft prompts, refine their outputs, and check the citations, a process that promoted digital literacy and academic integrity [30]. Critically evaluating AI-generated responses encouraged a mind-set of scepticism and verification, the attributes which are essential for public health professionals operating in data-rich environments [31, 32].

Quantitative findings from the post-intervention survey reinforced these impressions. Understandings. The students reported high levels of engagement (mean 4.1), improved understanding of occupational health (mean 4.0), and enhanced confidence in structuring data (mean 4.8). Additionally, they expressed a stronger appreciation for the role of AI in public health education (mean 4.6), as well as the need to verify its outputs (mean 4.4). These are in line with the findings in other blended-learning contexts, where the interplay of digital tools and real-world experience has enhanced both, retention and application of knowledge [33, 34].

Thematic analysis of qualitative feedback revealed five major benefits: (1) Improved comprehension, (2) Deeper engagement, (3) Stronger relevance to occupational health, (4) More effective learning, and (5) Clearer recognition of challenges. Students valued how AI helped them structure complex data into digestible tables and summaries. Simultaneously, many acknowledged that their firsthand observations during the industrial visit enabled them to interpret and critique AI content more critically [35]. This triangulation between field experience, digital outputs, and expert debriefing exemplifies the principle of mixed-method pedagogy [36].

Challenges identified by students such as limited preparation time for presenting the findings and a need for more localized or personalized AI content offer a valuable insight refinement in the future pedagogical approach. These are consistent with broader critiques of AI in education, especially around contextual insensitivity and the risk of providing "hallucinated" information [37]. Addressing these challenges requires clear scaffolding such as introductory sessions on AI literacy, examples rooted in local occupational health contexts, and structured peer-to-peer reviews [38].

This study reflects a shift in the educator's role from passive content deliverer to an active learning facilitator. Instructors guided students in using AI responsibly, emphasized the importance of referencing and verification, and provided corrective input during presentations. This method aligns with modern educational theories which emphasize reflective practice, inquiry-based learning, and meta-cognition [39, 40].

In the context of public health education, particularly occupational health, this blended and AI-integrated model presents a scalable, replicable approach for developing critical competencies. These include evidence-based analysis, collaborative learning, ethical reasoning, and digital literacy skills that will define the future readiness of public health graduates [41–43].

Conclusion

This manuscript is organized in two parts: (A) a descriptive account of the educational innovation and its pedagogical rationale, and (B) an evaluation of the intervention's outcomes through a structured research process. This structure allows readers to understand both the development and the impact of the blended learning model.

This study presents a pedagogical innovation that exhibits the power of blending experiential learning with emerging digital technologies in higher education. By integrating industrial visits, interaction with subject expert, structured content generation using generative AI, and critical analysis tasks, the intervention provided a holistic, student-centred learning experience. It moved beyond delivering passive instruction and created an environment where students were actively engaged in inquiry, applied theory learnt to real-world scenarios, and acquired essential digital literacy skills.

Findings from both quantitative and qualitative data support that a mixed-methods approach enhances student engagement, deepens understanding of the complex content, and strengthens essential competencies such as critical thinking, evidence-based reasoning, and collaborative problem-solving. Students not only learned to use AI tools for academic learnings but also developed the ability to critique and validate AI outputs, a skillset which is crucial for future-ready public health professionals.

This blended model shifts the role of educators from passive content deliverers to active facilitators of inquiry, creating space for the students to co-create knowledge through hands-on exploration, digital tools, and peer learning. As educational institutions increasingly seek ways to integrate AI meaningfully into curriculum, this study offers a replicable and scalable framework for pedagogical design that maintains academic rigor while at the same time embracing innovation.

Future research should explore long-term learning outcomes of such models to explore their adaptability across other domains of health education. Notably, this work reinforces the notion that Generative AI, when incorporated within a well-structured, experiential learning environment, can serve as a catalyst for deeper learning, reflection, and academic growth.

Limitations and considerations

While the intervention was well-received, several limitations were identified such as AI-generated content often lacked local relevance (e.g., regional industry-specific hazards). There is a potential for students to depend too heavily on AI, bypassing critical thinking unless properly scaffolded. Care was taken to anonymize personal narratives and train students on ethical use of AI, including citation practices and information accuracy checks.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-025-07850-z.

Supplementary Material 1.

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Authors' contributions

SP drafted the manuscript. SP, PS and LD revised and edited the manuscript. SP and PS conceived the study design. SP, PS and PG undertook recruitment of participants and collected the data. SP and PS supervised the conduct of study. All authors contributed substantially to its revision.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki (https://www.wma.net/policies-post/wma-declaration-of-helsinki/). Ethical approval was obtained from *Academic Technical Review Committee*, *Parul Institute of Public Health*. The reference number is PIPH/FOM/PU/2025/27/2, and written informed consent was obtained from all participants prior to their inclusion in the study. Informed consent was obtained from all participants prior to data collection. Participation was voluntary, and consent information was provided on the first page of the Google Form. Participants were required to read and acknowledge this information before proceeding to complete the form. Participation was voluntary, and confidentiality of the data was assured throughout the research process. In cases where personal narratives were included, all identifiable details were thoroughly anonymized and camouflaged to protect the privacy of individuals and maintain confidentiality.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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