

► INTERNATIONAL PERSPECTIVES

Preparing Future Environmental Health Practitioners Through Problem-Based and Community-Based Approaches: Experiences of Environmental Health Students

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Abstract Students learn better when they are engaged with real-world problems. This approach is especially effective for topics of environmental health, where students have limited exposure to fieldwork during their period of study. Hence, it is important to shift from conventional instruction-based methods to innovative pedagogical approaches. Problem-based and community-based learning offer academia the tools to prepare students via the development of essential problem-solving and analytical skills. Problem-based learning enables students to identify environmental health issues and develop feasible, realistic solutions to community problems. Furthermore, community-based learning allows students to learn through community engagement and generate solutions to real environmental health issues that communities face.

This study employed a qualitative approach to explore the experience of two cohorts of environmental health students regarding problem-based and community-based approaches. This study found that the students benefited from the respective approaches and gained valuable communication, leadership, problem-solving, and analytical skills that are crucial in the environmental health field.

Keywords: environmental health, problem-based learning, community-based learning, environmental education

Introduction

The world is continuously and rapidly evolving. The cohort of students currently studying at universities differs significantly from students of past decades. Likewise, pedagogical approaches should also evolve into methods that engage current students and cater to diverse learning styles. When conventional teaching methods are used, students

report a lack of engagement, even boredom (Özerk, 2020). Adopting interactive methods of teaching, such as problem-based learning (PBL) or project-based learning approaches, can address this problem. Lecture-based teaching is the most common method used across universities (Govender, 2016; Maphosa & Kalenga, 2012; McCullough & Munro, 2016), but some lecturers also

use innovative and interactive methods to enhance learning. In a South African study, Iputo and Kwizera (2005) found that academic performance increased with PBL or community-based learning (CBL; also called community-engaged learning) when compared with lecture-based curriculum. A gap in the literature exists, however, pertaining to environmental health studies and teaching methods in academia.

This study will contribute to our understanding of the experiences of environmental health students regarding pedagogical approaches that differ from the conventional lecture-based method. This article shares insights from two cohorts of environmental health students (third- and fourth-years). A focus group was conducted with participants from each cohort to understand their experiences. Study findings are presented according to the themes generated from the analysis of responses, with the final section providing commonalities across both cohorts.

The first section of this article presents a conceptual framework for PBL and CBL, including a literature review. Next, themes generated from the findings are presented. The findings allow for an evaluation of environmental health teaching methods as perceived by the student and can be used to inform the selection of pedagogies that encourage student engagement with environmental health content to generate crucial skills for future professionals.

Literature Review

The role of education is to develop individuals who are active, engaged, and able

to participate and contribute to society (Melaville et al., 2006). Initially, PBL was introduced into higher education because medical students found it challenging to integrate knowledge into clinical practice (Savin-Baden & Major, 2004). Problem-solving using real-world situations is viewed as a better teaching and learning technique than the traditional lecture-based model because PBL emphasizes developing skills in an interactive way while engaging the student (Diana et al., 2016). Moreover, Fischer et al. (2007) state that the traditional model of education is not appropriate if students are to learn how to find solutions for urgent and complex societal problems. These solutions require multidisciplinary engagement using an exploratory approach. Further, CBL provides the means to achieve these outcomes (Rau et al., 2022). This way of engaging with issues is a skill that could benefit students in the environmental health field—and thus instructors should teach these approaches and allow students to practice them.

Environmental health can be described as the field of public health that considers how chemical, biological, social, and psychosocial factors in the environment affect human health. The aim is to promote human health and well-being by preventing and controlling environmental hazards through the implementation of environmental strategies. It is a field with contributions from a range of disciplines, such as urban planning, epidemiology, law, ethics, occupational health and safety, and food safety. Frumkin (2016) described it as “environmental health thinking takes a systems approach, embracing complexity and focusing on ‘upstream’ factors as well as on ‘downstream’ health impacts.”

The Mangosuthu University of Technology (2024) in Umlazi, South Africa, states that environmental health students should be trained to evaluate the effectiveness and efficiency of control measures and to identify areas for improvement. Academia is tasked with teaching students to interpret and apply relevant environmental health legislation, regulations, and policies. All these areas require students to effectively communicate within a multidisciplinary team and with the community, as well as apply their training to offer public health services within the scope of environmental health.

Problem-Based Learning

Collaborative problem-solving has been described as “an important 21st-century skill that is increasingly recognized as being critical to efficiency, effectiveness, and innovation in the modern global economy” (Graesser et al., 2018). PBL allows students to work on case studies either in groups or individually. The idea is to identify problems and propose solutions (Amin et al., 2020). This practice is beneficial for public health students because they can engage with global practices to find solutions. There is no right or wrong answer; the aim is to find reasonable and sensible solutions to the given problem (Febriasari & Supriatna, 2017).

Research advocates for PBL as a tool to develop the skill of applying knowledge and independent learning to find strategies in an effective manner over traditional learning methods (Febriasari & Supriatna, 2017). PBL has been described as “significantly more effective” than lecture-based teaching for the development of trained environmental health practitioners who are competent and skilled (Ströbel & van Barneveld, 2009).

A study conducted among environmental health undergraduate students in Chicago, Illinois, reported that students enjoyed learning via a problem-based approach. The students reported that PBL was initially unfamiliar because they had been predominantly exposed to a lecture-based approach. The new learning style allowed them independence in their learning and to practice their knowledge, while providing them with a sense of empowerment (Akinmoladun, 2008).

Community-Based Learning

CBL is a pedagogical strategy in which the community is a partner in the learning process (Wood, 2017) and allows students to develop a sense of connection with their communities. Melaville et al. (2006) state that there is often a disconnect between classroom learning and the real world, and that students often do not reach their full potential when only one form of teaching is offered in the classroom. The authors further emphasize the need for CBL as a method to engage and motivate students.

Moreover, CBL builds relationships between the learning organization and local communities. This method provides an opportunity for the student to invest time and effort because

they view their learning engagement as meaningful and purposeful (Karasik, 2020). The theoretical foundation of CBL suggests that knowledge is created and guided by social interactions (Held et al., 2019). Memory is influenced by experience and practice, and motivation to learn is influenced by one’s perceived abilities and importance, along with the achievability of the learning goal. For intentional learning to occur, the main factors that affect students—community, school, and home—must be connected through education (Melaville et al., 2006).

Methods

A qualitative exploratory approach was used for this study. Descriptive data collection was the most appropriate method based on the study objectives. The aim was to understand the experiences of third- and fourth-year environmental health students. The third-year class was exposed to an assessment designed using a PBL approach, and the fourth-year class was exposed to an assessment using a CBL approach. Both assessments were incorporated into prerequisite modules 1 and 2 of the Environmental Health Management and Administration course.

For the PBL approach, students were placed into groups of three and given a theoretical scenario that simulated a real-world community environmental health problem. Students were given a guideline for how to do the assignment and write the report. The assignment aimed to expose students to a PBL task of developing crucial problem-solving and analytical skills relevant to the environmental health profession.

The CBL assignment allowed the students a level of autonomy appropriate for students in their final year of study. The assignment allowed students the freedom to select their own group members and determine the community they would work with. Groups were given a guideline for how to do the assignment and write the report.

Periodic progress updates were requested from all groups. Ethical clearance was received from the institution before the start of the study.

Research Site

The study involved environmental health students at a university. The program offers a 4-year bachelor of health sciences degree,

although only students in their third and fourth year were involved in this study. A purposive sampling technique was used, as there was an identified cohort of participants required for the study (Creswell, 2021). The aim of this study was to explore the experiences of students regarding a specific phenomenon that the two groups of students were exposed to.

Participants

Only third- and fourth-year students enrolled in the environmental health program were invited to participate in this study. In total, 38 third-year and 32 fourth-year students participated. Participants were informed about the study during the lecture prior to the commencement of the PBL or CBL initiative. After the completion of the learning initiatives, students were invited via an email to participate in a focus group. The details of the focus group were shared with students who responded to the email, and informed consent was obtained before the focus groups met.

Focus group 1 consisted of 6 third-year students and focus group 2 consisted of 10 fourth-year students. The focus groups were held separately to avoid influence or confusion. Participants were given identifiers (e.g., P1, P2) for ease of reference during the discussion.

Focus Groups

The focus groups took place in the boardroom of an academic department at the university. Students were invited to attend on a day that was most convenient for them. The focus group was guided using questions to assess student experience regarding the learning technique they were assigned to. General questions reviewed the overall teaching and assessment methods experienced during the academic period, followed by specific questions pertaining to the technique being evaluated. The session concluded with allowing students the opportunity to share any recommendations for improvement in teaching and learning approaches. Focus group 1 lasted 45 min and focus group 2 was 1 hr; both sessions were recorded and transcribed by the researcher.

Data Analysis

Students were assigned random identifiers that were pre-marked at each seat to ensure anonymity in the transcription of the focus group discussion. Transcripts were analyzed

by highlighting themes to the research questions and were peer-checked for accuracy. Using the transcriptions, the researcher examined the data set and categorized the findings using Creswell's 6 steps of qualitative data analysis. The 6-step flow analysis was used by initially transcribing audio recordings; generating categories, themes, and subthemes to identify important issues; and establishing trustworthiness (Lincoln & Guba, 1985; Miles & Huberman, 1994).

Results

Problem-Based Approach

Students were asked about the most common methods of teaching and assessment they were exposed to during the prior 3 years. Lecture-based approaches were mentioned by the majority of students, with students also reporting they had to do self-directed learning (e.g., use textbooks from the library, read articles, conduct their own research) to supplement lecturer-directed content. Practical exposure and community engagement were also mentioned, but not as common approaches. Group work and individual learning were generally used as assessment methods; however, students had differing views regarding the effectiveness of group work.

- I generally don't like group work because, personally, I feel like I get things done the way I like it. It's a thing of someone not cooperating. (P6)
- The assignment that they usually give to us is group work. Group work is good and bad because if other students are not willing to cooperate, I feel like it's on me to do everything. I can say it's good because you get the ability or skill of collaborating with other people. (P3)

Theme 1: Gaining Environmental Health Skills

Students enjoyed the PBL experience and were able to identify the development of environmental health-specific skills from the approach. Many students acknowledged that these skills are fundamental, particularly in the field of environmental health. PBL allowed them the opportunity to view themselves as environmental health practitioners (EHPs) through understanding community environmental health problems and systematically finding ways to address them. Problem-solving skills, practical skills, ana-

lytical skills, and communication were all mentioned by students. They cited having learned or developed these skills via engaging with the PBL approach.

- You are able to evaluate and analyze a situation and actually use your past knowledge on how to address the situation. I felt like it was a lot more practical, and I personally work well with practical learning. (P6)

Students were also able to identify inherent skills that they were not aware they possessed. This realization developed a sense of confidence in participants, even for students in their third year of study.

- There are certain skills that I didn't have. Like I can now figure out I do have this skill, and I can work with it. (P3)

Using real-world issues to encourage students to think about environmental health problems holistically is crucial. Students must think beyond the conditioned cause-and-effect route and delve into applying research skills to fully evaluate a problem from all angles.

- I also learned research skills—when you have a problem you could research or search for other relevant issues or factors that could influence that problem, so I personally also developed research skills of finding [the] association between those things. (P1)

The PBL approach allows for the formation and practice of using such skills. Students applied practical and analytical thinking skills in tackling the problem that was presented to their group. Two students (P2 and P3) mentioned feelings of enhanced creativity and ownership of the work.

- Usually, they tell us the theory, but we don't know much about how to do things practically, so during this assessment, we were able to do things practically, to observe and give solutions to that problem. (P4)
- When learning something from notes, it gives you one example or two that I can get a reflection of but with that approach (problem-based), you are able to actually take the work and make it practical. Especially when working out in the field, you never know what problems you will encounter. It helps us to identify this is something that could happen, this is how I can deal with it. (P6)

The PBL approach encourages students to use a plethora of skills designed to prepare

students to provide environmental health services to communities.

- I also learned communication skills when it comes to group work, how to communicate with others. (P5)
- I also learned to be responsible for doing my work and also analyzing skills. (P2)

Loureiro et al. (2009) support this concept by explaining that there is a need for a workforce that is appropriately competent to effectively perform core functions. The authors state that pedagogy is the means by which these competencies can be achieved. One study showed that PBL has a significant effect on student problem-solving skills and scientific writing skills (Sari et al., 2021).

Most importantly, students gained skills in engaging with communities, which is a core function of EHPs.

- I feel like it helps us better to engage with communities, to understand the communities, because most of the time we are only exposed to our own surroundings therefore we have our own perceptions, so when we get to engage with the communities and see with problem-based approaches, we get to understand that not every community is the same like mine or I can't address every community from my own perspective. I'm able to, before going to the community—let me analyze the situation, let me ask, let me find out and do my own research—come up with a solution that is suitable for that community. (P6)

This engagement might be the most important contribution of such an educational approach, as environmental health relies on the ability of the EHP to deliver interventions that are specific to a community. These interventions should be free of any predispositions or notions, which can be difficult to navigate (Meidert et al., 2023). EHPs have been found to display unconscious implicit biases, which can affect the level of service they provide to communities.

Theme 2: Group Work Versus Individual Learning in Problem-Based Approaches

Students reported many negative feelings about group work, with the cons seemingly outweighing the pros. Students were asked if they thought PBL would be better as an individual assessment or as a group activity.

- I think it would have been better if we did it as an individual assessment or at least

in pairs, so that each individual will be exposed to how to collect information on that particular section or subtopic. Because group work just does not work—not everyone participates. (P1)

- I think working in pairs is also good because with just the two of us, we have to do the work, [rather] than the five of us and some won't do the work. (P2, P3)
- I would do it as an individual but also in a sense, as an individual you get to evaluate for yourself and solve the problem yourself. For example, we present and get to see how someone had a similar problem as you, how they assessed it, how they viewed it, and how they solved it. That's how we can learn from each other. (P1)

Two students disagreed, however, and said they felt that group work was the better option.

- Group assessment is good because everyone shares their opinion about the topic, so we get more skills from other people. (P4)
- Group work is good if everyone is participating. (P5)

Group work decreases the demand on students and shares the workload. Students noted this aspect for PBL, stating that it was less demanding because the workload was distributed, making it easier to research and develop solutions for the problem. Despite the negative views of group work, it can yield many benefits. Group work builds collaborative skills (Le et al., 2017), communication and research skills (Chu et al., 2017), social skills, and accountability (Kokotsaki et al., 2016).

Theme 3: Developing Environmental Health-Specific Problems

Students appreciated the relevance of the PBL scenarios that encouraged them to draw on content from all modules in establishing the link between the profession and academic theory.

- In other modules, we did assignments that are not about environmental health at all. And other modules we did some assignments like case dockets, and we went to a court and heard about criminal cases which are not relevant to EH. (P5)
- I think some of the modules lack to explain to us the association (like P5 said), that some assignments are not about environmental health. I think they should give us something that makes us to understand

what is it that is expected from us as an EHP. Like the case docket, what is our point of view? What are we supposed to get from doing the assignment? (P3)

- Some people don't know the role of an EHP, so if there is an issue that is similarly related to what an EHP is supposed to do, then they ask them. In that sense, it was good (problem-based approach) and it will help us in the future. (P6)
- I also think the topics were more relevant to us as future EHPs because it gave us a deeper understanding of what is required from us as EHPs, and they also gave us skills of solving real-life problems. (P1)

PBL could be particularly beneficial for teaching environmental health, as it achieves the outcomes required for the development of skills needed by future EHPs. The problems allowed students to understand their role as EHPs in the different scenarios that were presented to them, which provided them with clarity about their professional identity. Cruess et al. (2019) believe that curricula should support students in the development of their professional identity and assist them as they progress toward becoming professionals.

Students explained that they understood environmental health concepts better after engaging with the problem-based scenarios.

- In a sense, it gave us insight into what is expected of us as future EHPs. (P6)
- Some of us, when we started, we did not understand the course, but now there's more understanding. (P5, P4)
- I feel like the problem-solving approach is way better than handwritten assignments. (P1)

Students also agreed that this approach could work with other modules, provided clarity was given about the association between the assignment and the module content. It was clear that students found it challenging to make the connection between some assessments and activities to the profession, which highlights the need for an approach such as PBL. This approach provides students with the opportunity to practically apply the content to a scenario and highlights the connection between the problem presented and the scope of practice.

There were, however, challenges with the PBL approach. Students recommended that for the approach to work, prior expla-

nation and briefing from the lecturer are needed for them to know what is required. Other students echoed this comment for assignments across all modules, noting that assignments were given as just the topic with little guidance on what was required. This need for more explanation is especially true if PBL is new to students and they are unfamiliar with the concepts and categories within the report.

- It's just that some of the assignments we did without understanding what we were supposed to do. I think some they did try to give us a mind map, but it wasn't clear about what we were supposed to do, so we were confused. (P3)

This approach may be an ideal way to achieve long-term learning so that students can remember how to solve environmental health problems in the field.

- We do learn the modules and we do grasp the concept of each module, but when we work in the field it's not like, "Oh, on Tuesday, we learned this and now I'm going to apply it," whereas if you say I was given this scenario before, I'm familiar with this type of scenario and this is what I did, so I am able to apply it to my work field. (P6)
- I think that if lecturers used the problem-based solving method it would be better, because it would help students understand the EHP's scope of practice better. It would help students know how they can face real-world problems and help them develop skills. (P1)

Students once again highlighted the disconnect that exists between the content and the environmental health field. One student explained that there is a lack of clarity between the scope of practice and the duties of EHPs.

- I think when they are teaching, they should also redirect us more to the duties of EHPs more than the scope of practice, because I think the scope of practice is broad. Like we went to abattoir and I thought we are the ones who are supposed to offload pigs but that is not the case, we only inspect. So, it wasn't clear. (P3)

It can be concluded that PBL offered an array of benefits and was enjoyed by the students. PBL offers a promising opportunity to academics as a pedagogy that is effective in achieving desired outcomes, particularly in environmental health.

Community-Based Approach

Theme 1: Significant Learning Experiences

There were several skills that students mentioned having gained from CBL. Students discussed how time management was a crucial skill needed to complete the assignment within the allotted time. Being in their final year of study, coupled with the demand from other modules, time management was key to ensuring that the students completed all their tasks on time. As with any profession, an individual's time management abilities directly affect their productivity.

Furthermore, the ability to communicate well is a skill that EHPs must possess, as their role is to work with community members and other key people. One student (P8) noted gaining experience communicating with other EHPs and members of local government to arrange meetings and source information.

- We gained communication skills as well as communicating with different people within the community. It was also a challenge because some residents couldn't really understand us, but we managed to get through to them, so we gained communication skills. And we worked with senior EHPs. (P3)

EHPs engage with different people (e.g., from industry, government, academia, health organizations) in performing duties within the scope of practice and must be able to effectively and confidently communicate with these groups. Effective communication was identified as central to effective teamwork in a study that evaluated the effects of multidisciplinary training performance and efficiency (Murphy et al., 2016).

Students also began to understand that messages to community members need to be tailored to the audience, and the approach taken with community members is not the same as it is with professionals. Health communication should be culturally sensitive and align with the norms, values, preferences, and beliefs of the population to enhance the impact and relevance of the message (Griffith et al., 2024). Students need to be aware of these core principles of public health.

- We had to stop using "science words" so the community members could understand us. (P5)

Students gained the ability to understand community problems from a holistic point of view. They were able to think beyond

the environmental problem and analyze the situation, considering the social and health implications for community members. This approach also ignited a sense of ownership and passion for the profession. Students developed confidence in seeing the project through to the end. Students were leaders of their own community project—from inception in discussion with communities and local government officials to providing environmental education to communities.

- I also got to understand being an EHP is more than just a profession. You also have to be able to empathize with the community and their situations. You have to be there and understand their situation, how they deal with their situation, and how it affects them. (P9)
- I think I have learned that if you go into the community, you have to put yourself in their shoes so they know you are listening to them. (P10)

Theme 2: Gaining Professional Identity

Students engaged with either community members or officials from local government in completing previous assignments; however, they had not been trained on how to communicate with these individuals beforehand. This lack of training contributed to the low confidence that they reported when communicating with community members or professionals.

Further, CBL helped students gain confidence when providing environmental education to communities, which while challenging, helped students to learn.

- Based on our group assignment—our problem was on burning pollution—for us to be able to try and explain the risk and problems with pollution to the people in that community, it wasn't easy, but we tried our best to tell people to reduce burning trash because of the sicknesses associated with pollution. (P6)
- For me, I would say what was amazing was me gaining confidence in actually carrying out this project. Like now, I'm the real EHP, that's how I felt [with] the confidence and the leadership skills. (P2)

After completing their 4-year degree, students embark on community service, during which they are expected to function as an EHP. Thus, it is imperative that students are trained with the skills that enable them to

adapt from a student to an independent professional with minimal disruption.

- I think the confidence is better because if I do community service next year and I go into the community, I can implement what I learned this year and in previous years. It won't be a surprise. I won't be caught off guard. I would be able to do it. (P1)

CBL is an effective mechanism for environmental health education, as it allows students to combine the knowledge and skills gained across all environmental modules. Students can understand how the culmination of the content informs the practice of environmental health, and it helps them to develop a sense of professional identity.

- You go to the community, you communicate with the community and the community members, you identify their problems and everything you've learned from all the other modules. It starts coming into place like, okay this is the problem, this is the scope of practice, this is the challenge, this is the health effect. You start making this puzzle and making all these connections and for me, that's what I enjoyed about the assignment. (P1)
- I've learned to be patient and to explain to them why I see a need to solve the problem that they have. (P10)
- Before you even communicate with them, you can already identify certain issues and when you start talking to them, then you start making a connection like, okay this is really what is happening, it's really an issue to the community members. (P1)
- I feel like it gave me the skill to prioritize problems. I need to deal with this problem first because if I deal with this problem first, I'll be able to mitigate other problems. (P9)

Students enjoyed the CBL approach; however, as with the PBL approach, group work

posed a challenge. One student (P5) mentioned that CBL was a better approach than others; however, it was unanimous that students preferred working on their own rather than working in a group.

- If you're with group members who are slacking, then it's not nice. Then I feel like I'd rather have a written assignment that I have to do by myself. (P1)
- I feel like individual assignments are better than group work. (P10)

Students might not understand the value of group work or working in a team yet, but it is crucial to develop certain skills that are needed for the working world. Learning to work with different personalities, tackling challenges with group members, and learning to contribute as a leader or member of a team are all critical elements needed in environmental health, especially given the multidisciplinary nature of the profession.

Discussion and Conclusion

The students valued both the PBL and CBL pedagogies, mentioning the valuable learning experiences gained from each. Using the approach with third- and fourth-year students was advantageous, as the students were adequately prepared to engage and appreciate the method. They recognized the benefits of the approach for the development of skills required by EHPs. Loureiro et al. (2009) advocated for a shift from traditional pedagogy to a PBL approach for the acquisition of "basic public health competencies."

The pedagogies provided students with real-world experiences, which required them to apply their knowledge along with the relevant skills needed to execute the task. Anazifa and Djukri (2017) evaluated the effect of project-based learning and PBL and found that these approaches positively affected

student creativity and critical thinking. The development of such skills is nonnegotiable for the present workforce, especially EHPs.

This study provides insights into the experiences of two cohorts of students who were presented with a PBL or CBL approach. Student education level at which the approaches were introduced was demonstrated to be appropriate, efficient, and effective. Students were adequately prepared with background and contextual knowledge and skills to engage with each approach and thus were able to receive the associated benefits. The approach was successful only when students were provided with enough guidance and instruction, which is important to note for the development of these approaches. It is also encouraging that students could identify the skills they developed from each approach and apply the knowledge and skills gained to generate a better understanding of environmental health and their role as EHPs.

Challenges and areas for improvement were identified. Students mentioned time as a challenge. These learning approaches were part of many other assignments and tests that the students had to navigate as a part of their semester. The approaches also required a level of consultation with individuals outside of the university (e.g., EHPs in the field), which added to the required time. One student suggested scheduling the due dates of smaller assignments to happen before the final project, which would facilitate time management and enhance participation. ✨

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References

- Akinmoladun, T.M. (2008). The relevance of problem-based instruction to learning about environmental health. *Journal of Environmental Health*, 71(1), 12–14.
- Amin, S., Utaya, S., Bachri, S., Sumarmi, S., & Susilo, S. (2020). Effect of problem based learning on critical thinking skill and environmental attitude. *Journal for the Education of Gifted Young Scientists*, 8(2), 743–755. <https://doi.org/10.17478/jegys.650344>
- Anazifa, R.D., & Djukri, D. (2017). Project-based learning and problem-based learning: Are they effective to improve student's thinking skills? *Jurnal Pendidikan IPA Indonesia*, 6(2), 346–355.
- Chu, S.K.W., Reynolds, R.B., Tavares, N.J., Notari, M., & Lee, C.W.Y. (2017). *21st century skills development through inquiry-based learning: From theory to practice*. Springer. <https://doi.org/10.1007/978-981-10-2481-8>

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References *continued from page 31*

- Creswell, J.W. (2021). *A concise introduction to mixed methods research* (2nd ed.). SAGE Publications, Inc.
- Cruess, S.R., Cruess, R.L., & Steinert, Y. (2019). Supporting the development of a professional identity: General principles. *Medical Teacher*, 41(6), 641–649. <https://doi.org/10.1080/0142159X.2018.1536260>
- Diana, N., Karyanto, P., Suciati, & Indriyati (2016). The application of e-module based on problem-based learning to improve critical thinking ability and reduce misconception on ecology material in the students of X MIPA 1 SMA Negeri 5 Surakarta in the school year of 2014/2015. *Biologi, Sains, Lingkungan, dan Pembelajarannya*, 12(1), 242–247. <https://www.neliti.com/publications/176152/the-application-of-e-module-based-on-problem-based-learning-to-improve-critical>
- Febriasari, L.K., & Supriatna, N. (2017). Enhance environmental literacy through problem based learning. *Journal of Physics: Conference Series*, 895, Article 12163. <https://doi.org/10.1088/1742-6596/895/1/012163>
- Fischer, G., Rohde, M., & Wulf, V. (2007). Community-based learning: The core competency of residential, research-based universities. *International Journal of Computer-Supported Collaborative Learning*, 2(1), 9–40. <https://doi.org/10.1007/s11412-007-9009-1>
- Frumkin, H. (Ed.). (2016). *Environmental health: From global to local* (3rd ed.). Jossey-Bass.
- Govender, S. (2016). Students' perceptions of teaching methods used at South African higher education institutions. *South African Journal of Higher Education*, 29(3), 23–41. <https://doi.org/10.20853/29-3-486>
- Graesser, A.C., Fiore, S.M., Greiff, S., Andrews-Todd, J., Foltz, P.W., & Hesse, F.W. (2018). Advancing the science of collaborative problem solving. *Psychological Science in the Public Interest*, 19(2), 59–92. <https://doi.org/10.1177/1529100618808244>
- Griffith, D.M., Efrid, C.R., Baskin, M.L., Webb Hooper, M., Davis, R.E., & Resnicow, K. (2024). Cultural sensitivity and cultural tailoring: Lessons learned and refinements after two decades of incorporating culture in health communication research. *Annual Review of Public Health*, 45(1), 195–212. <https://doi.org/10.1146/annurev-publhealth-060722-031158>
- Held, F.P., Roberts, C., Daly, M., & Brunero, C. (2019). Learning relationships in community-based service-learning: A social network analysis. *BMC Medical Education*, 19(1), Article 113. <https://doi.org/10.1186/s12909-019-1522-1>
- Iputo, J.E., & Kwizera, E. (2005). Problem-based learning improves the academic performance of medical students in South Africa. *Medical Education*, 39(4), 388–393. <https://doi.org/10.1111/j.1365-2929.2005.02106.x>
- Karasik, R.J. (2020). Community partners' perspectives and the faculty role in community-based learning. *Journal of Experiential Education*, 43(2), 113–135. <https://doi.org/10.1177/1053825919892994>
- Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, 19(3), 267–277. <https://doi.org/10.1177/1365480216659733>
- Le, H., Janssen, J., & Wubbels, T. (2017). Collaborative learning practices: Teacher and student perceived obstacles to effective student collaboration. *Cambridge Journal of Education*, 48(1), 103–122. <https://doi.org/10.1080/0305764X.2016.1259389>
- Lincoln, Y.S., & Guba, E.G. (1985). *Naturalistic inquiry* (1st ed.). SAGE Publications, Inc.
- Loureiro, I., Sherriff, N., & Davies, J.K. (2009). Developing public health competencies through building a problem-based learning project. *Journal of Public Health*, 17(6), 417–424. <https://doi.org/10.1007/s10389-009-0256-7>
- Mangosuthu University of Technology (2024). *Department of Environmental Health*. <https://www.mut.ac.za/faculty-of-natural-sciences/departement-of-environmental-health-2/>
- Maphosa, C., & Kalenga, R.C. (2012). Displacing or depressing the lecture system: Towards a transformative model of instruction for the 21st century university. *The Anthropologist*, 14(6), 555–563.
- McCullough, K., & Munro, N. (2016). Finance students' experiences of lecture-based active learning tasks. *Innovations in Education and Teaching International*, 55(1), 65–73. <https://doi.org/10.1080/14703297.2016.1189843>
- Meidert, U., Dönnges, G., Bücher, T., Wieber, F., & Gerber-Grote, A. (2023). Unconscious bias among health professionals: A scoping review. *International Journal of Environmental Research and Public Health*, 20(16), Article 6569. <https://doi.org/10.3390/ijerph20166569>
- Melaville, A., Berg, A.C., & Blank, M.J. (2006). *Community-based learning: Engaging students for success and citizenship*. Coalition for Community Schools. <https://files.eric.ed.gov/fulltext/ED491639.pdf>
- Miles, M.B., & Huberman, A.M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). SAGE Publications, Inc.
- Murphy, M., Curtis, K., & McCloughen, A. (2016). What is the impact of multidisciplinary team simulation training on team performance and efficiency of patient care? An integrative review. *Australasian Emergency Nursing Journal*, 19(1), 44–53. <https://doi.org/10.1016/j.aenj.2015.10.001>
- Özerk, G. (2020). Academic boredom: An underestimated challenge in schools. *International Electronic Journal of Elementary Education*, 13(1), 117–125. <https://doi.org/10.26822/iejee.2020.177>
- Rau, H., Nicolai, S., & Stoll-Kleemann, S. (2022). A systematic review to assess the evidence-based effectiveness, content, and success factors of behavior change interventions for enhancing pro-environmental behavior in individuals. *Frontiers in Psychology*, 13, Article 901927. <https://doi.org/10.3389/fpsyg.2022.901927>
- Sari, Y.I., Sumarmi, Utomo, D.H., & Astina, I.K. (2021). The effect of problem based learning on problem solving and scientific writing skills. *International Journal of Instruction*, 14(2), 11–26. <https://doi.org/10.29333/iji.2021.1422a>

References

Savin-Baden, M., & Major, C.H. (2004). *Foundations of problem based learning*. McGraw-Hill Companies, Inc.

Ströbel, J., & van Barneveld, A. (2009). When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *Interdisciplinary Journal of Problem-Based Learning*, 3(1), Article 4. <https://doi.org/10.7771/1541-5015.1046>

Wood, L. (2017). Community development in higher education: How do academics ensure their community-based research makes a difference? *Community Development Journal*, 52(4), 685–701. <https://doi.org/10.1093/cdj/bsv068>

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