SDGs in Cross-School Outdoor Learning: Water Resource Exploration via Cycling

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The Paris Conference on Education 2025
Official Conference Proceedings

Abstract

The purpose of this paper is to describe the development process of an outdoor education curriculum integrated with the Sustainable Development Goals (SDGs). It was developed by teachers concerned with SDG issues from two riverside schools located in the same river basin but on different tributaries in northern Taiwan. Using the ORID (Objective, Reflective, Interpretive, Decisional) focused discussion method as a framework, the teachers collaboratively developed and refined the curriculum. The course begins with guiding students through outdoor field observations to record findings and establish emotional connections with nature. It then raises awareness of sustainability issues related to the SDGs, using diverse perspectives and criteria to filter information. Finally, through cross-school sharing, discussions, role-playing, and debates, the course examines potential solutions to sustainability issues and encourages value-based judgments. The results show that (1) the course structure, combining outdoor investigations and the ORID discussion method, effectively achieves educational goals related to the SDGs; and (2) after this course, students can apply the method to other sustainability issues, further fostering their love for their homeland.

Keywords: SDGs, outdoor education, ORID, water resource, cycling

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Introduction

Human beings are closely connected to the environment. Teaching programs—especially in science education that involves real-life contexts—are very important. Compared to traditional classrooms that focus heavily on knowledge acquisition and efficiency but lack real-world application, outdoor education facilitates the transformation of knowledge, emotions, skills, attitudes, and behaviors through direct engagement with the outdoor environment, benefiting individuals, families, society, and the planet. To help students develop their cognitive, emotional, and behavioral traits, it is strongly recommended to take them out of the classroom and guide them through inquiry as a problem-solving experience within natural surroundings (Lee, 2020). This approach also encourages students to develop problem-solving skills and make decisions collaboratively (Maesaroh & Sriyanto, 2022). International research also indicates that integrated outdoor curriculum programs, such as those implemented in Ontario, Canada, can significantly contribute to students' engagement and learning outcomes (Valkova, 2017).

The United Nations' 2030 Agenda for Sustainable Development provides guidance on designing curricula that connect students to real-life experiences and their surrounding environments (United Nations, 2015). It also supports educators in identifying sustainability-related issues to create appropriate teaching programs. In Taiwan, schools and educational authorities have increasingly emphasized outdoor education. The "Guidelines for the Establishment of the Outdoor Education Promotion Committee," issued by the Ministry of Education in January 2014, outlined the vision of outdoor education as "learning everywhere, with everyone as a teacher." Furthermore, the "2016–2019 Outdoor Education Achievement Sharing Session," held by the Ministry of Education in 2019, highlighted Taiwan's alignment with the SDGs and emphasized the integration of outdoor education with history, humanities, subject knowledge, and natural ecology. However, both students and teachers often demonstrate limited ability to connect science with everyday life, highlighting the need for educators to strengthen this connection (Ummuhan & Salih, 2018). Sustainable ways of interacting with the environment are still not fully integrated into all levels of education, and educators continue to face numerous difficulties and challenges. Interdisciplinary, inquiry-based courses in outdoor education remain scarce in the current school curriculum. Students in urban areas have fewer opportunities to interact with nature, while those in rural areas often lack the necessary resources to support outdoor learning. Furthermore, during the COVID-19 pandemic, students around the world were required to stay home for learning, which significantly limited their interaction with the natural environment. On the other hand, both teachers and students have become increasingly familiar with online learning platforms. The implementation of asynchronous courses has enhanced students' data-mining skills and expanded opportunities for inquiry and collaboration. With the widespread use of mobile devices, students can now easily bring their own devices into outdoor learning environments. Therefore, this is an ideal time for educators to leverage mobile technology in outdoor education.

In the post-pandemic era, the role of teachers has shifted from that of lecturers to facilitators. Teachers can scaffold students' learning by guiding them through a process that begins with site selection and route planning and continues through field observations, recording and sharing findings, identifying problems, formulating hypotheses, and engaging in surveying, reasoning, argumentation, and decision-making. These steps all contribute to a comprehensive inquiry-based learning experience. Outdoor education is an inquiry-based learning approach that fosters a connection with nature. In this approach, students are

expected to actively explore the natural environment through observation, investigation, questioning, and problem-solving (Hmelo-Silver, 2004). As inquirers, students must first identify problems they genuinely care about and believe are worth solving. This initial engagement fosters motivation and supports deeper inquiry and research, helping them develop knowledge and skills through the problem-solving process. The ORID method, developed by Laura Spencer of the Institute of Cultural Affairs (USA), is grounded in Kolb's Experiential Learning Model (Kolb, 1984) and was first formally published in Winning through Participation (Spencer, 1989). It offers a structured framework for discussions and reflections by guiding participants through a sequence of questions. ORID stands for Objective, Reflective, Interpretive, and Decisional. These four stages help students make objective observations, reflect on their experiences and emotions, interpret the meaning behind their findings, and ultimately make informed decisions or draw conclusions (Institute of Cultural Affairs, 2001).

Therefore, the research question guiding this study was:

> "What are the planning and implementation processes involved in developing cross-school collaboration on SDG-related issues using the ORID model?"

Theoretical Framework

Outdoor Education

Numerous research studies have shown that students can develop stronger cognitive, physical, social, and emotional skills when teachers take them outdoors. Teachers who use the natural environment as an extension of the indoor classroom can enhance students' academic achievement and promote lifelong positive behaviors (Ruether, 2018). Compared to traditional classroom-based instruction, students tend to be more active and engaged in outdoor settings (Dettweiler et al., 2015). Engaging in learning activities in outdoor environments not only leads to longer-lasting learning outcomes but also supports cross-disciplinary learning through direct interaction with the natural world (Becker et al., 2017).

1. Students can make meaningful connections between what they have learned and their daily lives.
2. Students learn through multisensory experiences.
3. Students participate in outdoor education with greater motivation.
4. Students have more opportunities to interact with one another through physical movement.
5. Students' social skills are developed throughout the learning process.
6. Students' behavior improves when they are in close contact with nature (e.g., students with ADHD).

Students who live in large cities often have limited access to natural environments. However, teachers can provide opportunities for them to engage with "semi-natural" spaces, such as riversides. It is highly anticipated that students will demonstrate different learning outcomes when participating in such outdoor courses.

Inquiry-Based Learning

Inquiry-based learning can be described as consisting of five general phases: Orientation, Conceptualization, Investigation, Conclusion, and Discussion (Pedaste et al., 2015). It is also regarded as a teaching approach aimed at enhancing students' understanding of scientific

concepts and the nature of science. The learning of subject matter, principles, and critical thinking skills is integrated with scientific knowledge and practice (Kelly, 2008). Students engage in various inquiry-based activities, such as collaborative tasks involving reading, asking questions, planning investigative methods, collecting and interpreting data, drawing conclusions, and generating new insights. These activities extend beyond the sciences into fields such as the social and cognitive domains (Bybee, 2000; Furtak et al., 2012; Hmelo-Silver et al., 2007). According to a study on teachers' perspectives regarding inquiry-based learning, Tal et al. (2019) found that teachers highly valued the outdoor environment for learning and provided insightful suggestions on integrating in-school and out-of-school learning. Based on these findings, it is strongly recommended that educators design courses, implement them in practice, and take students outside the classroom to engage in inquiry-based learning—especially in subjects such as natural sciences and environmental education.

ORID Inquiry

ORID inquiry is based on the four cyclic stages of Kolb's (1984) Experiential Learning Theory. The acronym ORID stands for:

- Objective – The facts: What does the group know about the issue or experience?
- Reflective – Emotional response: What did the group feel about the issue or experience?
- Interpretive – Meaning and learning: What has the group learned from the issue or experience? What do these learnings mean?
- Decisional – Response or evaluation: What conclusions or future actions should be taken?

The ORID process helps group members engage in focused conversations by considering each participant's opinions and evaluating the levels of agreement or disagreement on specific topics. It also facilitates feedback and reflection among participants. When a teacher acts as a guide during outdoor exploration, students may have diverse observational experiences, thoughts, feelings, and judgments. To harness these perspectives, teachers can apply the ORID framework to lead structured, in-depth class discussions and explorations. This helps students identify issues worth exploring and ultimately leads to appropriate solutions.

ORID provides educators with a strong scaffold for instructional design, and its steps should be followed sequentially. Coutts and Roberts (2014) proposed a set of guiding questions, as shown in Table 1.

Table 1

Workshop Notes on Methods

ORID Elements	Focus	Suggested questions
O Objective	Getting the facts	• What did we do today? • How did we do it? • What do you remember from today? • What did you hear or see? • How many people were there? • Who was involved, what was said?
R Reflective	Emotions, feelings, associations	• How did you feel? • What was your first response? • What other feelings did you experience? • Did you like this or not? • Where do you remember the whole group reacting? • How did your apprehension change or your confidence grow?
I Interpretive	Value, meaning, purpose, learning	• What would you say were the main points? • What did this mean? • What were the main messages? • What did you learn? • Which of these actions should be first priority?
D Decisional	Future steps	• In what ways can you apply what you saw today to your farm? • How might the things you observed today change what you do on your farm? • What can you or will you use or follow up from today? • What would you say about this event to someone who was not there?

Source. Coutts J&R. (2014)

Method

Classroom Action Research

Action research is an interactive method used to gather information related to teaching, curriculum development, and students' behavior in the classroom. However, traditional educational action research often emphasizes personal reflection by educators, with research contexts largely confined to their own classrooms—therefore limiting generalizability. This study can be regarded as a cross-school Classroom Action Research (CAR) project, in which two researchers from different schools explored the same SDG-related sustainable development topic (i.e., water resource issues) through localized outdoor education programs tailored to their respective teaching contexts. Through online interactions, discussions, and exchanges between teachers and students from both schools, the study aimed to identify universally recognized values. Practitioner inquiry (Orland-Barak, 2009), teacher research (Cochran-Smith & Lytle, 1999; Zeichner, 2003), and technical action research (Kemmis, 2009) can be integrated within the CAR framework. CAR can be seen as a method for determining what works best in a given context to improve student learning. In this study, the researchers—who also served as classroom teachers—aimed to enhance students' learning outcomes related to localized outdoor education through changes in their instructional practices.

Context of This Study

The two researchers in this study teach at junior high schools located in the metropolitan area of northern Taiwan. The schools are approximately 25 kilometers apart in a straight line and are situated near two tributaries—the Keelung River and the Daham River—both of which feed into the Tamsui River. Each researcher designed and implemented a localized curriculum focusing on water resource issues related to their respective rivers. Taking advantage of this action research opportunity, the two researchers collaborated to co-design the curriculum. Through outdoor education, they guided students to conduct field investigations along the riversides. Under the framework of the ORID inquiry model, students began with observation and documentation, shared their findings with peers, and participated in interactive exchanges between the two schools. Students posed in-depth questions based on their observations and reflections, formulated preliminary interpretations, and ultimately identified suitable solutions through data collection, interpretation, and discussion. In addition, the researchers engaged in ongoing discussions and revisions before, during, and after the implementation of each lesson unit, ensuring that the curriculum design was broadly applicable and suitable for joint implementation by both schools.

Design

The researchers designed learning activities suitable for outdoor water resource investigations, taking into account the established teaching objectives as well as the learning environments and backgrounds of students from both schools. A teaching module was also developed to guide interactive exchanges between students at the two schools. After each session, the researchers refined the instructional design and adjusted activity details based on student feedback. The final research process design is as shown in Table 2.

Table 2

Steps for the Final Course Implementation

Researchers clarify educational objectives (refer to SDG issue)	
Researchers design instructional plans with ORID	
School A Local outdoor learning nearby Keelung river	School B Local outdoor learning nearby Daham river
Sharing Observations and Reflections after outdoor activities between schools	
Questions and ideas focused	
Discussion & Problem solving & Decision making between schools	
Researchers evaluate and reflect on the outcomes of students	

Participants & Procedures

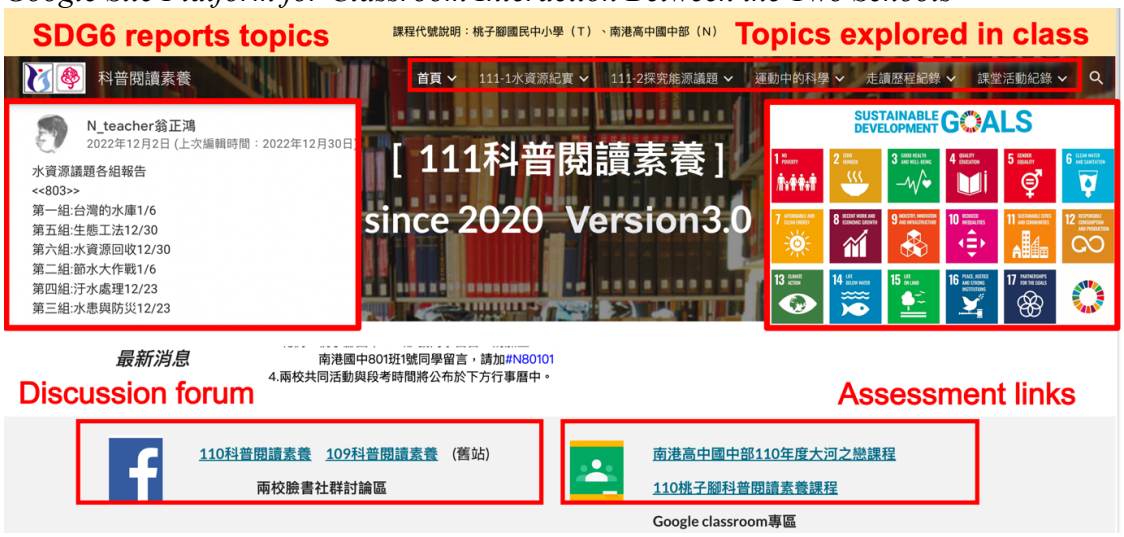
This action research project has been implemented continuously since 2020, involving approximately 120 eighth-grade students each year (two classes from each school). Despite the challenges posed by the COVID-19 pandemic, the program proceeded without interruption. Students from both schools utilized various online platforms to support collaborative learning: Facebook was used for discussions; Padlet and Google Sites were employed to organize and share findings and reflections from outdoor investigations; and Google Meet facilitated remote interactions, Q&A sessions, and synchronous class discussions. Initially focused on water resource issues, the curriculum expanded to include other SDG-related topics after two years of implementation. These additions introduced more complex inquiries and activities involving value-based judgments—for example, the topic of nuclear power generation. A summary of the course implementation is presented in the section titled Students' Achievement and Reflection.

Students' Achievement and Reflection

The collaboration between the two schools began in September 2020. In the first year of the partnership, the researchers began by examining the existing curriculum structures of both schools and establishing a mechanism for student interaction. To support collaborative "science reading," the researchers created a Google Site platform where teachers from both schools shared key curriculum content for students to access and discuss (see Figure 1). In addition, a Facebook community was established to facilitate interactive discussions. The two researchers, who also served as subject teachers—one with a physics background (School A) and the other with a mathematics background (School B)—approached the same topics from different curricular perspectives. In addition to sharing course content, the researchers regularly introduced SDG-related sustainability topics on the Facebook platform, encouraging students from both schools to participate in discussions through the comment sections. Each school also hosted unique "highlight courses" through special "expert sessions." For instance, the teacher from School A conducted remote lessons with School B's students via Google Meet, while the teacher from School B led supplementary sessions on Facebook during after-school hours. This stage was considered the "foundational phase" of the collaboration between the two schools.

Figure 1

Google Site Platform for Classroom Interaction Between the Two Schools

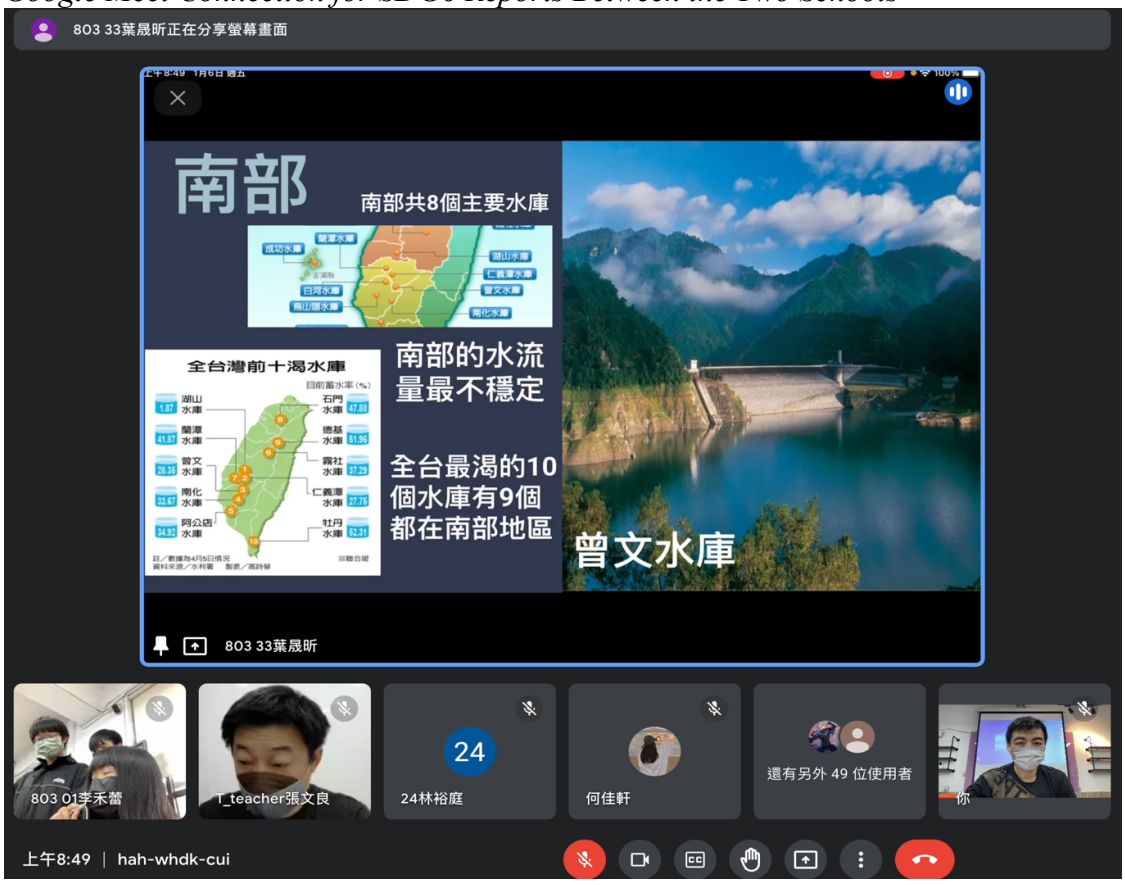


The second stage of curriculum development (September 2021 to June 2022) marked a critical phase for refining and focusing the curriculum structure. During the summer of 2021, the researchers selected SDG-related topics from the existing course themes at both schools, with a specific focus on water resource and energy issues. In the early stages of this phase, several challenges emerged, including suboptimal internet connectivity and students' unfamiliarity with real-time online interaction tools. Interactions between the two schools were primarily conducted on a “class-to-class” basis. For example, during the same class period, the researchers used Google Meet to connect students from both schools (see Figure 2). Students presented pre-prepared reports on water resource topics using PowerPoint. The researchers facilitated interaction and guided Q&A sessions, while also providing feedback and critiques on each group’s presentation.

In May 2022, Taiwan experienced a surge in COVID-19 cases, prompting all schools to shift to online learning. Although students involved in this project were more accustomed to remote instruction compared to their peers, it was their first time attending classes entirely from home. This transition introduced new challenges, including technical issues related to software, hardware, and internet stability, as well as difficulties with students’ self-discipline and teachers’ classroom management. However, after about a month of adaptation, students gradually became familiar with online self-study, digital assignment submissions, and participation in remote video classes and interactions. This experience laid a solid foundation for deeper curriculum collaboration in the future.

Figure 2

Google Meet Connection for SDG6 Reports Between the Two Schools



In the third year of the course collaboration (September 2022 to June 2023), the world gradually emerged from the threat of the COVID-19 pandemic. After several months of online learning, students—who had spent extended periods immersed in virtual environments via mobile devices and other digital tools—began to exhibit various aftereffects of prolonged online engagement. In response, Taiwan's education system placed renewed emphasis on promoting outdoor education, enabling students to reconnect with nature. The two researchers, both outdoor sports enthusiasts, had prior experience leading students on bicycle trips to rivers for investigations at their respective schools. Drawing on the ORID-focused discussion method described in the literature, the researchers guided students on bicycle rides along riverside paths to conduct outdoor investigations on water resource issues. After completing their observations, recordings, and reflections, students were encouraged to share their findings, experiences, and questions for further discussion with their peers from the other school through remote collaboration.

The researchers observed that, despite the different routes taken due to the geographical separation of the two schools, this form of sharing not only connected information across different areas of the Tamsui River Basin, but also helped students focus on common water resource issues—such as wastewater treatment, flood prevention, disaster mitigation, and water use efficiency. At this stage, "bicycle outdoor investigations" were formally integrated into the curricula of both schools, serving as a core component of the "O" (Observation) and "R" (Reflection) phases within the ORID framework (see Figures 3 and 4). By this point, the curriculum had shifted from a teacher-led approach to a learner-centered model, in which students identified sustainability issues based on their own lived experiences. The habit of "riding shared bicycles" developed during these outdoor investigations evolved into an actionable plan aligned with the principles of sustainability, promoting the use of eco-friendly transportation. This practice reflects the spirit of sustainable development while fostering environmentally responsible habits among students.

Figure 3

Students Share Their Observation

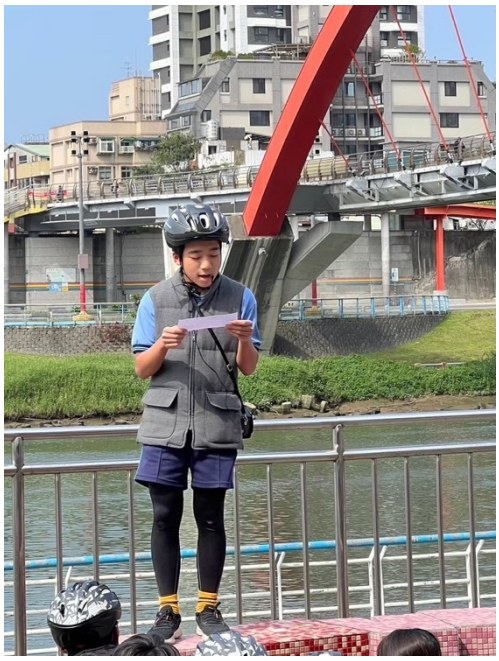


Figure 4
Bicycle Outdoor Investigations

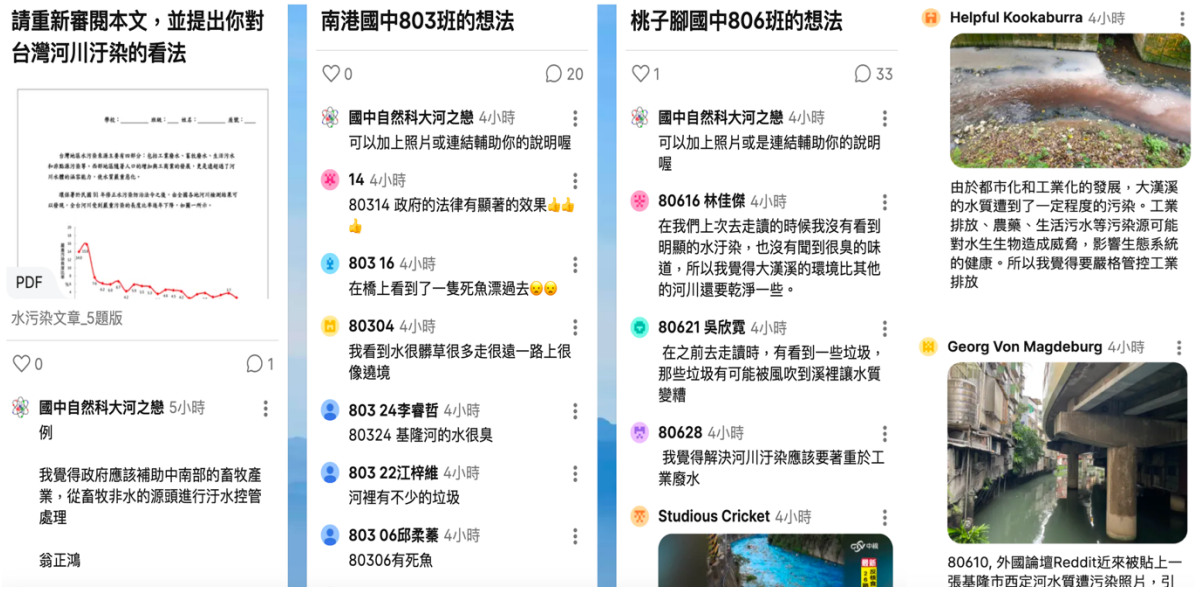
The fourth year of the course collaboration (September 2023 to June 2024) marks a critical year in which the course framework reaches full maturity. Junior high school students entering this academic year have already become familiar with operating online learning software during the COVID-19 pandemic. Their experience with building and using various learning websites has also equipped them with basic abilities for exploration and self-directed learning through the internet.

The Ministry of Education in Taiwan's "One-Tablet-Per-Student Initiative" policy has further enhanced schools' hardware infrastructure, such as mobile devices and internet connectivity. In addition, the development of artificial intelligence, led by tools like ChatGPT, has brought new opportunities to the implementation of this course.

Under the guidance of teacher-researchers, students can now leverage AI to refine the outlines of their reports, design PowerPoint presentations, focus more sharply on discussion topics, and propose more constructive problem-solving solutions as shown in Figure 5. At this point, the role of the teacher has shifted from being an "instructor" to a "facilitator." Similarly, instructional design has evolved from initially "providing inquiry questions" to "creating environments that inspire student inquiry."

Figure 5

Students Use AI to Help Discuss of SDG 6 Issues and Share Them on Padlet



The primary concern for instructional designers now lies in creating environments that enable students to begin with observation, generate emotional responses, identify issues, move into interpretation, and ultimately propose solutions through decision-making based on their insights.

This instructional model can be effectively adapted to a wide range of SDG-related sustainability issues, serving as a replicable and successful framework for designing SDG-integrated curricula.

Conclusion

In summary, our findings suggest that implementing the ORID outdoor education inquiry process in a cross-school collaboration setting can effectively achieve the following instructional objectives:

1. Recognize SDG issues as cross-school, cross-regional, and global topics, fostering students' awareness of and concern for diverse environmental issues.
2. Enhance students' interaction with the surrounding natural environment, thereby improving their observational abilities and problem-identification skills.
3. Promote exploration of SDG issues from multiple perspectives through data interpretation and inter-school collaboration.
4. Enable students to conduct in-depth analyses of various dimensions and viewpoints related to SDG issues, helping them develop value-based judgment criteria and make informed decisions.

Based on the experience gained through this project, we propose the following recommendations for future course development:

1. Facilitate more face-to-face cross-school exchanges, such as collaborative outdoor education initiatives.
2. Organize community visits around school campuses to broaden curricular perspectives and strengthen ties to local culture.

3. Integrate bilingual education components to enhance students' readiness for future international collaborations.
4. Develop SDG-themed programs that are open to public participation, thereby raising awareness of environmental education and sustainable development among families and communities.

This course module centers on "water resource issues" as its primary theme, featuring the design and implementation of related outdoor education activities. Through practical classroom application, the module evaluates its feasibility and effectiveness. Moving forward, we welcome collaboration with additional educational institutions interested in SDG-related topics, to further explore curriculum optimization and expand issue-oriented inquiry.

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