

BOARD #100: Work In Progress: Analyzing the effects of AI powered tools on STEM Learning and Pedagogical Research

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WIP: Analyzing the Effects of AI-powered Tools on STEM Learning and Pedagogical Research

Introduction

Artificial intelligence (AI) has emerged rapidly as a transformative force in engineering education, particularly in pedagogical research. While numerous studies have explored AI's effects on learning outcomes in early education settings—such as kindergarten, primary, and secondary schools—evidence of its efficacy in higher education is still limited [12, 15]. Existing educational AI tools face limitations in fostering meaningful conversations, as their responses often lack the natural interaction and adaptability of human communication [22, 23]. This work-in-progress paper utilized an AI-driven survey tool to enhance STEM learning outcomes, with a focus on fostering collaborative skills that are critical in today's educational landscape. By comparing traditional, static reflective prompts with dynamic, AI-generated survey prompts, this research aims to evaluate how generative AI can promote deeper engagement and meaningful learning in higher education.

Effective teamwork is a fundamental component of STEM learning, especially given the growing emphasis on collaboration and communication skills in higher education. Yet, many college students face challenges in addressing complex, real-world problems due to insufficient collaborative abilities. Research has shown that while collaborative learning environments enhance problem-solving, reflective, and critical thinking skills, many students struggle with group dynamics and effective teamwork due to unequal participation and reliance on stronger team members, limiting their ability to address real-world challenges [7, 8].

To tackle this issue, we have developed an innovative AI-driven open-ended reflective tool that dynamically generates personalized questions based on students' prior responses, instructional context, and educational theories surrounding effective teamwork. This work-in-progress paper presents preliminary data on the impact of a reflection instrument on biomedical engineering students using a randomized controlled trial. Analysis of four representative examples of student conversations highlights both the strengths and limitations of AI-powered tools in STEM education. We hypothesize that students will reflect deeper when prompted with personalized questions. AI-generated prompts encourage diverse reflections, engage students, and support regulatory learning, and the tool effectively rephrases questions to enhance engagement. Our methods and AI survey provide insights into the potential of AI in STEM education research and have contributed to further studies [14].

Methodology

Participants and Demographics

The study involved 38 students enrolled in the BME 2081 Experiential Learning Seminar course during the Fall 2024 semester, a 1-credit advanced biomedical engineering course with a design concentration. The cohort was predominantly women (72.97%) and racially and ethnically diverse. Additionally, 60.5% of students reported having at least one parent with a master's degree or higher, indicating a majority with familial exposure to advanced education. Comprehensive demographic data can be found in Appendix G.

Course Structure and Teamwork Instruction

Students were explicitly taught teamwork skills through lectures, shared value setting, and structured exercises. They participated in group projects designed to simulate real-world problem-solving scenarios, including the *Desert Island Activity*. In this activity, teams of four to five students were provided with a box of essential supplies and tasked with collaborating on a survival scenario: rescuing and treating “Leah,” a fictional team member with a severe leg injury.

Each team member assumed a unique character role with specific abilities and backstories. Working under resource constraints and time pressure, teams developed a strategy to address Leah's medical needs, fostering collaboration and teamwork.

Reflection and Experimental Design

Following the *Desert Island Activity*, students engaged in reflection exercises addressing teamwork dynamics and course learning objectives. Reflection prompts were divided into two groups: (1) **Predefined Question Group**: Students answered predefined questions developed collaboratively by the research team and course instructors and (2) **Generative AI Question Group**: Students responded to AI-generated questions. Questions 2-5 were dynamically generated based on students' prior responses, while the first question mirrored the predefined group for consistency. The AI-powered reflection tool, integrated into the Qualtrics platform, was deployed six times throughout the course, generating over 700 individual responses. Unlike traditional AI educational tools, this Qualtrics-based tool adopts a more conversational approach, helping to mitigate bias. Using the same platform also enables direct comparisons between static and AI-generated questions.

Data Collection and Analysis

A total of 735 student responses were collected across the Predefined and AI-generated Question Groups. Our analysis focused on identifying patterns and variations in how students regulated their motivations and emotions related to teamwork. This investigation drew on theories of learning regulation [1, 2, 16-18], emphasizing three categories: self-regulated learning (SRL), co-regulated learning (CoRL), and socially shared regulation of learning (SSRL). SRL reflects students' efforts to regulate their own behaviors, emotions, or motivations to enhance teamwork. CoRL involves students supporting or influencing their teammates' emotional states or actions to foster mutual progress. SSRL occurs when teams collaboratively engage in regulatory processes, such as setting shared goals, negotiating roles, or resolving conflicts.

The data was analyzed using quantitative coding of instances of SRL, CoRL, and SSRL across responses, comparing their frequency between the predefined and AI-generated prompt groups. This was complemented by a qualitative thematic analysis to uncover other ways in which the students engaged in the reflective process with the two tools. From the dataset, three exemplary cases were selected from each group for in-depth analysis, representing common patterns and emphasizing notable differences between the two groups. These cases, detailed in Appendices A–E, provided a rich lens through which to examine how different prompts influenced reflective practices.

While evidence of reflective ability, particularly related to teamwork has been understudied, we adopt Boud's framework for "good" reflection, the analysis also evaluated the depth and authenticity of student reflections, looking for evidence of "processing their experience in a wide range of ways, exploring their understanding of what they are doing, why they are doing it and the impact it has on themselves and others [19]." AI-generated prompts, designed to adapt to students' prior responses and instructional context, were hypothesized to encourage deeper reflection by facilitating a balance between emotional and cognitive engagement. The questionnaire and methodology of this study were approved by the IRB at Cornell University (IRB0148748).

Preliminary Results

The analysis revealed that AI-generated questions effectively encouraged some students to reflect from multiple perspectives—individual, team, and teammate-oriented. In *Summary of Reflection 1*, AI prompts such as "You," "Your team," and "Your team members" facilitated a

shifting in focus, prompting students to examine their roles within the group and the impact it has on themselves and others. This approach elicited action-oriented responses, such as “We are trying to” and “I suggested,” and emphasized collaborative processes, as seen in phrases like “Collaborating with other members.” These responses align with principles of regulated learning theory [1,2,16-18] and “good” reflective practice [19], demonstrating the AI tool’s capacity to prompt reflections that draw from multiple perspectives. The dynamic framing of questions in this conversation highlights the effectiveness of AI in fostering deeper engagement with team-related reflections.

Q1: Describe **your** role in the desert island activities, and do **you** enjoy this position and the activity, why or why not?

R1: **I enjoyed the role because it allowed me to** apply knowledge from physiology and BME classes creatively. **This made me value** the concept of bringing different perspectives when approaching a challenging situation.

Q2: How did **collaborating with team members** contribute to the creativity and effectiveness of your problem-solving?

R2: Each member contributed unique insights, improving ideas through discussion. **This helped me expand my view** of the problem and better prioritize key aspects of the solution.

Q3: How did the diverse perspectives from **your team members** in different roles influence your decision-making process?

R3: Diverse perspectives shaped our priorities in the treatment plan. **For instance**, the pharmacist focused on food poisoning, and the surgical intern prioritized wound care. **We were able to** identify key issues and develop a cohesive solution.

Q4: Can you provide an **example** of a **specific instance** where integrating the different perspectives from **your team members** led to a more innovative or effective solution for the treatment plan?

R4: When **we were trying to figure out** the medication treatment plan, we were able to combine multiple perspectives effectively. First, the teacher mentioned shrimp as a possible cause, and the pharmacist suggested medications targeting bacterial infections. **I suggested** a vaporized drug delivery method.

Q5: How did **your team** communicate and collaborate effectively to integrate these diverse perspectives into a treatment plan?

R5: **We started** with open discussions to set priorities, **brainstormed** individually, and then **reconvened** to share and refine ideas. This iterative process ensured effective collaboration and a cohesive plan.

***Summary of Reflection 1:** Questions 2-5 were AI-generated. Bolded phrases emphasize the diversity in question framing and the student’s responses (See Appendix A for the complete transcript).*

The *Summary of Reflection 2* shows how adaptable question phrasing can foster deeper student reflection. AI-generated questions successfully introduced new vocabulary and reframed existing topics, increasing clarity and engagement. For example, Q4: “How did **distributing leadership responsibilities** contribute to the activity?” got a superficial response (R4) that described leadership distribution in broad strokes without going into personal details. However, rather than repeating the word “distributed leadership”: the AI rephrased it in Q5, asking, “How did the **rotation of leadership roles** aid in leveraging individual strengths?” This linguistic shift elicited a significantly more deeply reflective and personal reaction (R5), with the student stating, “I got it now!! I wish I could change my previous answer.” The reframing allowed for a more in-depth reflection of their experiences, allowing them to articulate a wider range of opinions and team goals.

Q4: How did **distributing** the leadership responsibilities among team members contribute to a more collaborative and inclusive decision-making process during the desert island activity?

R4: Distributing leadership ensured everyone’s opinions were heard and made the process more collaborative and inclusive. Each member brought unique insights, helping the team identify key information and integrate it into a cohesive solution.

Q5: How did the **rotation of leadership** roles within the team during the desert island activity help in leveraging individual strengths and promoting a sense of shared responsibility among team members?

R5: By making sure everyone had to speak on what was on their paper (since they were the only one to read that paper), each person stepped into a leadership role. Since we rotated, we got to benefit from everyone’s different leadership strategy (**I change my answer from the previous response I get it now!!! I wish I could change my answer from that other prompt...**). So, when we asked particular questions (eg. the medicine they had to take) it put the responsibility mainly on the pharmacist so she was almost “forced” to step into responsibility. So, as various different questions came up each person was made to step into different key roles and we all had to be responsible.

***Summary of Reflection 2:** Questions 4 and 5 were AI-generated. Bolded phrases emphasize the diversity in word choices and the student’s responses (See Appendix B for the complete transcript).*

Despite the benefits of AI-generated prompts, some issues persist, notably with repetitious phrases. As seen in *Summary of Reflection 3*, repetitive use of similar language reduced student involvement and the depth of responses. In Question 2, the word “equal contribution” produced a detailed and thoughtful response (R2) with specific examples. However, the AI used the same phrase in future questions (their remarks in Q4: “*This answer is short because I have typed a very similar response for the past 3 question Q3-Q5*”), phrasing it to questions associated with collaboration, decision-making, consensus-building, and problem-solving. This lack of variance resulted in repeated responses, restricting the student’s capacity to offer new perspectives. The student appeared to be frustrated by the repetitive language, as evidenced by *ns*” and in Q5: “*As I stated before*”. These findings suggest that while dynamic prompts can enhance engagement, overly repetitive phrasing risks undermining the depth and richness of reflection. Such lack of engagement with the reflective process from the student is also observed in static questions, highlighting a common phenomenon that motivated us to personalize the AI tool.

Q2: Can you elaborate on how the **equal contribution** from each team member impacted the **overall outcome** of your desert island activity?

R2: Equal contributions meant everyone’s ideas were incorporated into the result. Personal preferences and expertise brought unique perspectives. For instance, my background in sterile dissection helped address infection control, while others focused on bacterial causes or basic first aid based on their experience.

Q3: How did the **equal contribution** from each team member enhance the **collaboration and decision-making process**?

R3: Equal contributions ensured fresh ideas were constantly introduced, avoiding over reliance on one person. Small ideas from individuals led to larger solutions, such as addressing wound care steps or knowing when to use a tourniquet. Diverse input ensured nothing was overlooked.

Q4: How did the **equal contribution** from each team member lead to more **effective problem-solving and consensus-building**?

R4: Each team member highlighted overlooked aspects, improving the final product. By addressing individual gaps in knowledge, the group created a more robust solution. (**This answer is short because I have types a very similar response for the past 3 questions.**)

Q5: Can you **provide specific examples** of how each team member’s **equal contribution** facilitated **problem-solving and consensus-building**?

R5: **One example as stated before:** originally, we planned to use iodine wipes, but a team member pointed out they cause cell death on open wounds. This insight helped us avoid harming the patient and demonstrated the value of group collaboration.

Summary of Reflection 3: Questions 2-5 were AI-generated. Bolded phrases highlight the repetitiveness in question framing (See Appendix C for the complete transcript).

Predefined questions, as analyzed in Conversations 4–6, consistent approach to eliciting reflections. For instance, prompts like “*Describe three things that you learned*” encouraged students to elaborate, however, we found that the responses often followed a structured format with sequential markers such as “First,” “Second,” and “Last.” While this facilitated organized reflections, the depth of analysis was often limited. For example, responses lacked critical self-assessment, which Boud defines as “the involvement of students in identifying standards and/or criteria to apply to their work and making judgements about the extent to which they have met these criteria and standards [19] nor actionable insights, focusing instead on descriptive or affective statements like “I enjoyed” or “I did not enjoy.”

In Reflection 4, R3 is characterized by sequential phrases such as First, Second, and Last; similar patterns can be found in Reflections 5 and 6 (see Appendices D, E, and F).

Q3: Describe **three things** that you learned from your teamwork experiences these two weeks.

R3: **First**, I learned the importance of quick and clear communication in high-pressure situations. **Second**, I realized that having a clear plan, even under time constraints, improves decision-making during engineering designs. **Lastly**, I gained an appreciation for creative problem-solving in biomedical engineering, as this scenario required innovative thinking for our design.

Summary of Reflection 4: All questions were predefined. Question 3 specifically required enumerated responses, facilitating structured reflection (See Appendix D for the complete transcript).

Aside from Q3, the other predefined questions in Reflection 5 effectively encouraged students to make actionable suggestions and share their thoughts and opinions. Statements like “*I am looking forward to next week’s activity*” and “*Improving by planning design would save time*” show a thinking and a focus on developing future methods. Reflection 5 demonstrates how these predefined questions can also help students reflect on their learning results and suggest actionable steps for future growth.

Q1: Describe your role in the desert island activities, and do you enjoy this position and the activity, why or why not?

R1: I was the surgical intern. I enjoyed the role as it allowed me to focus on challenges without last-minute updates. The activity encouraged critical and creative thinking, and **I look forward to refining our drug administration design next week.**

Q2: What were some of the challenges your team had during this activity this week?

R2: Communication was a key strength; we shared and built on each other’s ideas. **However, we could improve by planning our design broadly before building, which would save time and resources.**

Q3: Describe three things that you learned from your teamwork experiences these two weeks.

R3: First, communication is key to progress. Second, I learned to prioritize tasks during high-pressure events. Finally, planning ahead and making decisions as a group is essential in time-constrained situations.

Q4: Describe **two things that you didn’t understand** or are still confused about related to your teamwork experience in class today.

R4: I am **unsure** about the design plan, particularly administering the drug with the respiratory bag and whether the drug must be aerosolized. I was also **unclear** if we were expected to complete the treatment plan or treat the patient within 15 minutes.

Q5: Describe one thing that you enjoyed.

R5: I enjoyed working in a creative environment with no set instructions. **It felt like a lab session with more freedom, allowing us to focus on exploration rather than meeting expectations.**

Summary of Reflection 5: All questions were predefined. The bolded sentences illustrate the students’ comprehensive reflections on the course (see Appendix E for the complete transcript).

However, in comparison to AI-generated questions, predefined prompts appeared to place less focus on SRL. While students considered the constraints of their assigned responsibilities and the benefits of working with a team of leaders, their replies frequently lacked actionable or self-evaluative verbs, such as “I tried” or “I suggested.” Instead, subjective expressions such as “I enjoyed” or “I did not enjoy” were more common, implying that, while predefined questions facilitate systematic reflection, they may not fully motivate students to critically assess their actions and strategies from multiple perspectives within the team setting.

Q1: Describe how your team dynamics influenced the outcomes of your desert island activity this week compared to last week.

R1: My role was the kindergarten teacher. **I didn’t enjoy** it since I couldn’t provide valuable survival information, though **I appreciated** the challenge of adapting to an unfamiliar role. The activity encouraged creative thinking, but the timing of revealing secrets could have been better.

Q2: What were some of the challenges your team had during this activity this week?

R2: A key challenge was working in roles without real expertise, leading to disagreements. **For example**, the person in charge of medicine faced pushback due to lack of knowledge. However, creating a plan before modifying tools helped us avoid wasting resources.

Q3: Describe three things that you learned from your **teamwork** experiences these two weeks.

R3: First, **everyone thinks** about problems **differently**, and combining standard and creative ideas is effective. Second, I learned how to **work with a team of leaders**, where we **collaborated equally** to reach a consensus. Third, **listening to others’ expertise** prevents overanalyzing and ensures efficiency.

Q4: Describe two things that you didn’t understand or are still confused about related to your **teamwork experience** in class today.

R4: Some roles required knowledge that we didn’t have, making it hard to act as actual experts. Additionally, I wasn’t sure of the kindergarten teacher’s purpose, aside from sharing one secret.

Q5: Describe one thing that **you enjoyed**.

R5: **I enjoyed** the hands-on experience of building a simple biomedical device, which reminded me that BME solutions can be basic and effective in emergencies. It was a refreshing contrast to advanced lab equipment.

Summary of Reflection 6: All questions were predefined, eliciting strong reflections on teamwork, collaboration, and communication. (See Appendix F for the complete transcript.)

Discussion

The findings highlight both the strengths and limitations of AI-powered tools in facilitating STEM students' learning processes. AI-generated prompts effectively promoted diverse reflections, engaging students by eliciting thoughtful responses and supporting regulatory learning by prompting them to evaluate their team contributions. These tools demonstrated the ability to generate varied questions by rephrasing language, enhancing engagement. However, care should be taken to ensure the reading level and language complexity are appropriate, avoiding jargon that might hinder comprehension—something less common with predefined questions.

The study also identified challenges. A key issue was the perceived artificiality of the AI-generated prompts. Students often found the overly formal and structured tone unnatural, detracting from the reflections' authenticity [5, 13]. Prompts such as, "That's an interesting perspective. Can you elaborate on how letting others take the lead impacted the way the team communicated and made decisions?" felt rigid and included implied judgments uncommon in predefined prompts. Repetition of similar phrases further reduced engagement, with comments like, "I have already answered this," underscoring how redundancy stifled interest. The prompts appeared to occupy an "uncanny valley," where they were neither fully human-like nor clearly AI-generated. This ambiguity may have caused discomfort, as students perceived them as lacking both natural flow and the clear pedagogical intent of predefined questions.

The findings have important pedagogical implications. AI-generated prompts can deepen reflections by encouraging students to consider multiple perspectives and critically evaluate their learning. They also foster regulatory learning by prompting engagement with motivations, emotions, and actions. Research suggests that coached reflection enhances the learning process [24]. And stronger engagement with the reflection process may also produce higher-quality data for education research [14].

Overall, significant improvements are needed to enhance these tools. Algorithms should either mimic predefined prompts more closely or adopt a more natural, conversational style to address the perceived artificiality. Better prompt engineering can reduce redundancy and maintain engagement. Future work includes conducting further qualitative analysis across responses from the entire class as well as comparative studies across different disciplines, student demographics, and educational settings, which would provide broader insights into the generalizability of these findings.

Limitations and Future Work

A limitation of this study is the small sample size, which affects the generalizability of the findings. To address this, we have refined the system prompt and deployed the updated AI tool to a new student population, with plans for continuous deployment throughout the 2025 academic year to multiple courses across STEM disciplines. This expansion will help improve the robustness and applicability of the results. Additionally, because the reflection was part of a graded assignment, it is difficult to determine whether students were genuinely engaging with the reflection or simply fulfilling a requirement. We, therefore, plan on also developing a codebook to define what constitutes a "good" reflection. This codebook will incorporate established theories of effective reflection, such as those proposed by Boud, Gibbs, and Kolb [19, 20, 21], along with emergent themes derived from student data, faculty values, and learning objectives.

Acknowledgments

The author, Kangxuan Rong, would like to thank the BME 2080 students for participating in the research and master's student Rachel Bocian for her contribution to the BME 2080 course transformation.

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Appendix A: Full Transcript of Student A's Conversation

Student A	Questions	Student Responses
Predefined	Describe your role in the desert island activities, and do you enjoy this position and the activity, why or why not?	I was the product engineer, and I was giving advice about different methods of drug delivery to the unconscious patient. I enjoyed the position because I could bring in knowledge I gained from physiology along with my BME classes to engineer a solution , and this act made me feel really creative. I also like the thought of developing a product from scratch for a certain issue, and bringing the only engineering perspective from the roles made me feel unique in this way. The activity was also fun, as we engaged in meaningful discussion, especially because each member knew something different about the situation they could contribute to the end solution plan. I appreciate how the roles were very diverse, as even unexpected experiences like a pilot could lead to an interesting addition to the development of the treatment plan. This made me value the concept of bringing different perspectives when approaching a challenging situation.
AI-Generated	It's great to hear that you enjoyed your role as the product engineer in the desert island activity and found it to be a valuable experience. How did collaborating with team members in different roles contribute to the creativity and effectiveness of your problem-solving approach during the activity?	Collaborating with the team members in different roles helped emphasize the importance of valuing each members individual perspective and looking for ways to mesh this into the solution plan. In this case, I think since the roles were so diverse, ranging from a pilot to a pharmacist, we had to get creative in ways in which we could use each person's assets to make a meaningful contribution in the end. Collaborating with others helped the ideas improve as they were bounced back and forth, as members would mention factors others missed and other constraints/consideration. This helped expand my personal view of the situation , and at the end of the activity, I could say I generally better understood the solutions purpose and what was important to prioritize in this case.
AI-Generated	How did the diverse perspectives from your team members in different roles influence your decision-making process when developing the treatment plan for the unconscious patient scenario?	The diverse perspectives from my team helped influence the decision-making process in terms of priorities of what we wanted to address in our treatment plan. For example, the pharmacist who noticed the patient could have food poisoning was focusing on delivering medication to her to solve this first, whereas the surgeon intern was focused more on suturing her wound. Figuring out what aspects of the concerning situation to address with time as our constraint was the most difficult part here in the decision making process. However, by combining all of our different perspectives, we were able to talk through what we deem is the most significant, and from there used our perspectives to go about developing the solution plan and figuring out what we could personally contribute. Talking from different lenses helped make sense of the realistic expectations for the solution.
AI-Generated	Can you provide an example of a specific instance where integrating the different perspectives from your team members led to a more innovative or effective solution for the treatment plan?	When we were trying to figure out the medication treatment plan, we were able to effectively combine multiple perspectives into one. First, the teacher brought up that she ate shrimp with her hours before, and this could have upset her stomach and could be a factor in her impairment. Then, the pharmacist stepped in and suggested specific medications that target bacterial infections in the intestine, which was a helpful biological solution to the problem. After this, I as the product manager suggested we think about ways to deliver the drug, and suggested a mouthpiece that can vaporize the liquid drug and deliver it right to her blood stream without her being conscious. The pilot was the one who had access to the materials, so he was able to pull them out and show us the content we were working with. The surgical intern said that while we focus on delivering this drug, she would work on disinfecting and sealing off the wound so that two tasks could be done at once. In this way, we got many different perspectives on board to go about treating the patient.
AI-Generated	How did your team communicate and collaborate effectively to integrate these diverse perspectives into a cohesive and successful treatment plan for the unconscious patient scenario?	Our team effectively communicated and collaborated for this by starting off with some initial conversation on the situation and what we deem a priority in addressing. From here, we thought for a while individually about how we could add our perspective to this situation, and did some drafting on our large paper. After this, we reconvened to go over our individual contributions, and wrote down the big takeaways. We then circled back to the points we each thought were valuable from each other and merged the ideas together, raising questions to the group in the process. Finally, we worked on brushing up these specific ideas and putting the refined thoughts on the paper, and had successfully created a solution.

Appendix B: Full Transcript of Student B's Conversation

Student B	Questions	Student Responses
Predefined	Describe your role in the desert island activities, and do you enjoy this position and the activity, why or why not?	I was the kindergarten teacher. I didn't have much technical information or medical information to share but I still shared what the paper said my opinion was. I think it went pretty smoothly since we all listened to each other's opinion even though the surgical intern or pharmacist might have had a little more knowledge on what to do for this medical emergency. I enjoyed the activity since I normally step up to take the leadership position if no one else is doing it but this time I sort of stepped back and let myself just go with the flow. No one ended up stepping up as a leader position but it actually worked out which was surprising!
AI-Generated	It's great to hear that you played a supportive role as the kindergarten teacher and let others take the lead in the desert island activity. Reflecting on your experience, how did stepping back and not taking the leadership position benefit the team dynamic in this particular situation?	<p>Not taking the leadership position made the environment/mood of the group lighter and I think it made people feel more comfortable sharing their opinions. I also think the environment was more laid back than other stressful team situations I was in, so I adapted my response to that and felt like a leader position may not be fully needed.</p> <p>I think I tried briefly in the beginning, but it got too serious and they shifted the environment back – it was a little harder to focus the group since we were such good friends. Since we were good friends we didn't need a leader making sure everyone was heard since that was natural to us.</p> <p>I learned different situations call for different responses and in this case it was that they needed the environment to be more relaxed.</p>
AI-Generated	That's an interesting perspective. Can you elaborate on how letting others take the lead impacted the way the team communicated and made decisions during the desert island activity?	<p>Hmm.. I mentioned that no one took the lead here so I'm not sure the question makes much sense...</p> <p>But I can also see the value in letting others take the lead and me stepping back. I may not be the best leader overall but also I may not be the best leader for a particular circumstance. For example, in this activity I didn't have the medical expertise on the paper so for this medical emergency it may make more sense for those other people to take the lead.</p>
AI-Generated	How did distributing the leadership responsibilities among team members contribute to a more collaborative and inclusive decision-making process during the desert island activity?	Having different responsibilities was useful so that we made sure everyone's opinions were heard. Since everyone had different things written on their paper and some may be useful, we all wanted to hear what each other had to say. This then made it much more collaborative and inclusive because we had to figure out which information was key.
AI-Generated	How did the rotation of leadership roles within the team during the desert island activity help in leveraging individual strengths and promoting a sense of shared responsibility among team members?	By making sure everyone had to speak on what was on their paper (since they were the only one to read that paper), each person stepped into a leadership role. Since we rotated, we got to benefit from everyone's different leadership strategy (I change my answer from the previous response I get it now!!! I wish I could change my answer from that other prompt...). So, when we asked particular questions (eg. the medicine they had to take) it put the responsibility mainly on the pharmacist so she was almost "forced" to step into responsibility. So, as various different questions came up each person was made to step into different key roles and we all had to be responsible.

Appendix C: Full Transcript of Student C's Conversation

Student C	Questions	Student Responses
Predefined	Describe your role in the desert island activities, and do you enjoy this position and the activity, why or why not?	In comparison to last week's activities, our group worked in a very similar manner. Each person had time to voice their ideas, and then each of us had time to reflect on those ideas. It felt easier to work together as a group since we were no longer confined to the roles assigned last week. This meant that we were able to work more easily together and clearly focus on the most important tasks at hand. In terms of distribution of everyone contributing to the team, each individual contributed a very equal amount to the end project. This is what I believe is best for great teamwork, where each person can voice their opinions and speak clearly about the ideas they want to bring forth in the group. In how our overall group worked together, there is not much, if anything, I would change about it. Each member of our group had different ideas that all blended together and complemented each other well.
AI-Generated	It's great to hear that your team dynamics have improved since last week! Can you elaborate on how the equal contribution from each team member impacted the overall outcome of your desert island activity this week?	Since each group member contributed and equal amount, it meant that instead of having one team member dictate what we all should be doing, everyone's ideas were incorporated into the end result. Since people each had personal preferences on what parts they enjoyed working on, it meant that each person brought a new perspective and sense of light to the group project. It was also interesting to see how the areas of research that we all participated in also bring interest into the project. For example , my research involves dissecting joints and making sure they are sterile. This meant that I brought a point of view to the project that was more in the area of how to ensure that new infections don't spread in the body. Other people who worked on bacteria in the group then focused more on the potential for Leah to have a stomach infection and ways that we could address that. Also, being the daughter of a physician, I knew a few basic first aid tests and items to do when a person gets hurt, and you have very few medical supplies around to help.
AI-Generated	How did the equal contribution from each team member enhance the collaboration and decision-making process during your desert island activity this week?	Since each member was providing equal contributions, it meant that we always had a fresh idea to think about instead of focusing too much on one singular idea (which can happen when one person is contributing most of the ideas for a group). Each team member contributed multiple smaller ideas to then lead to one larger idea, which also meant that many aspects that each individual one of us would overlook were addressed as a whole. For example , items such as knowledge if iodine wipes were safe to use on open wounds, the order of how we clean wound matters, and the location on the body where one should tie a tourniquet all played large factors in creating a large overall successful group design. Many of these items were only to be known because each group member was contributing new information to advance the plan, and it was made possible because we had diverse ideas to begin with.
AI-Generated	How did the equal contribution from each team member lead to more effective problem-solving and consensus-building during your desert island activity this week?	As stated before, each team member brought up information that other members did not think about. This meant that many aspects that a singular person would overlook were then pointed out as important by other individuals to better create the final end product. (This answer is short because I have types a very similar response for the past 3 questions.)
AI-Generated	Can you provide specific examples of how each team member's equal contribution facilitated problem-solving and consensus-building during the desert island activity this week?	One example, as stated before , was knowledge about the order of cleaning a wound for dressing it. For example, originally we were going to use the iodine wipes in our first aid kit, but we then learned from one of our team members that these whips cause a large amount of cell death and are not to be used on open wounds. This meant that without this group member's insight, we would have done something to our patients that would have hurt them more than helped them.

Appendix D: Full Transcript of Student D's Conversation

Student D	Questions	Student Responses
Predefined	Describe how your team dynamics influenced the outcomes of your desert island activity this week compared to last week.	I believe we used our time more efficiently this week to come up with a device design. I think that knowing what was expected of us from last week and having an idea of possible designs we could implement helped us work better together. We were able to come up with a protocol and test different things with our design during the allotted time.
Predefined	What were some of the challenges your team had during this activity this week?	One challenge we had to work through this week was regarding our device design. We were trying to connect the tubing from the oxygen mask to the tube used to blow up the life vest. Our goal was to fill up the life vest, then use it to pump sufficient air into the oxygen mask, however the tubing of the oxygen mask was too thick. The solution we found was to use the tube inside the spray bottle and run it into the tube of both the life vest and the oxygen mask tube.
Predefined	Describe three things that you learned from your teamwork experiences these two weeks.	The first thing I learned was the importance of quick and clear communication during high-pressure events. Second, I learned that it is important to make a clear plan of what to do before starting an engineering design, even if there is a time constraint as it allows you to make better decisions. Finally, I learned the importance of creative thinking in biomedical engineering, as the desert island scenario required us to think out of the box for our design choices.
Predefined	Describe one thing a team member did that you thought was helpful.	One thing one of my team members did that I found helpful was pointing out the fact that it would be easier to administer the medication if it was an aerosol, as Leah was unconscious and couldn't swallow liquid medicine. This allowed us to make informed design choices and focus on possible ways we could construct a nebulizer-like device.
Predefined	Describe one thing that you enjoyed.	One thing I enjoyed about this activity was that it pushed us to think outside of the box as a team and use our creative thinking and problem solving skills. I enjoyed being able to design a device without being given instructions or a certain procedure, and being able to make our own protocol.

Appendix E: Full Transcript of Student E's Conversation

Student E	Questions	Student Responses
Predefined	Describe your role in the desert island activities, and do you enjoy this position and the activity, why or why not?	I was the surgical intern in the desert island activity. I enjoyed my position as I didn't have last minute news to share to my teammates and therefore could focus on the challenges they presented. The activity allowed us to think both critically and creatively, as we tried to decide on what treatments Leah needed and how we could administer them to her. I'm looking forward to continue on developing our design to administer the drug next week.
Predefined	What were some of the challenges your team had during this activity this week?	One factor that definitely benefited our teams' progress was our communication. We all shared our own point of view of the situation(without spoilers) and everyone listened to each other, making remarks and building off of each other's ideas. One thing I believe we can do better as a team is coming up with a broad plan of our design looking at all the resources we have instead of going right into building. Even though planning ahead might seem time consuming we collectively agreed that it may allow us to use our time more effectively.
Predefined	Describe three things that you learned from your teamwork experiences these two weeks.	First of all , communication is key. I would attribute most of the progress we made as a team to our effective communication. Second , I got a sense of what to prioritize during high pressure events and saw how I would operate personally during such an event. Finally , I learned the importance of planning ahead and coming to decisions as a group in time constrained situations.
Predefined	Describe two things that you didn't understand or are still confused about related to your teamwork experience in class today.	I still have some questions about our design plan, which I believe we will be able to resolve as a team when we meet next week. We were planning on administering the drug with the respiratory bag, but we would need the drug to be in an aerosol form for that. On another note, I wasn't quite sure if we were supposed to come up with a treatment plan by the end of the time or if we were supposed to treat the patient during the 15 minutes (which is what we tried to do, but it was difficult with the additional facts we learned during the 15 minutes.)
Predefined	Describe one thing that you enjoyed.	I enjoyed that I got a chance to work with my teammates in a creative environment with no set instructions. It resembled a lab section with more freedom, which allowed us to work without trying to meet a set of expectations.

Appendix F: Full Transcript of Student F's Conversation

Student F	Questions	Student Responses
Predefined	Describe how your team dynamics influenced the outcomes of your desert island activity this week compared to last week.	My role in the desert island activity was as the kindergarten teacher. I did not enjoy my position because there was almost no valuable information I could provide to the group to help save the girl or help the group survive in general (except the fact that she ate food without sharing it). In a life or death situation such as this, I would have preferred to be in a role where I could be of more use, either medically or just with basic survival skills. I enjoyed the activity overall though--it was interesting to be forced to take roles that we were not used to and think through survival without having many tools -- rather than just playing ourselves as characters. However, the timing of revealing secrets at certain points only in the game did not work out too well, but other than that I think it was a beneficial activity (even more so if you don't know your group very well).
Predefined	What were some of the challenges your team had during this activity this week?	One issue my team had was that because these weren't roles that we actually had expertise in, other people were trying to make decisions for other roles. For example, for the one in charge of the medicine, he didn't actually know everything about the drugs in reality so there was push back about his decisions from other people in the team with different real-world knowledge. However, the team was able to progress well overall due to the fact that we created a plan of action before actually modifying any of the tools we had -- so we didn't waste any material by breaking something before we came up with a final plan of action.
Predefined	Describe three things that you learned from your teamwork experiences these two weeks.	I learned that everyone has a different way of thinking about problems and that being able to combine both standard survival/medical practices with out-of-the box ideas about how to use our limited resources was the best way to solve the scenario. The second thing I learned from the experience was how to work in a team of 4 people where everyone is used to taking the leadership role. In groups this size, I often try to take on a leadership role in order to make sure we are progressing steadily (since often in 'bigger' groups people are hesitant to make final decisions after we all pitch ideas). However , with this group, everyone was used to this role, so we instead all worked together on the same level and were able to come to a final group consensus together. The third thing I learned was that in order to progress more efficiently in our work, it is necessary to listen to the expertise of the others' roles, instead of getting bogged down in the what-ifs of every medicine or route of action.
Predefined	Describe two things that you didn't understand or are still confused about related to your teamwork experience in class today.	The only thing I wasn't sure about was that for some of the roles, it required a significant amount of outside knowledge that many people don't have at this point, so it was hard to have actual experts for each role. Another thing I wasn't sure about was the purpose of the kindergarten teacher. I was able to provide that one secret piece of information later on in scenario, but before that all I could really do was insist that she was probably dehydrated. I did end up helping with the final design of our prototype but if we were actually sticking to our roles, I probably wouldn't have in real life. I am just wondering if there was a different purpose for the teacher that I might have missed.
Predefined	Describe one thing that you enjoyed.	I enjoyed being able to gain hands-on experience building a make-shift biomedical device. Normally, especially at Cornell, all of the instruments and technology we work with is very advanced, so it is easy to forget that biomedical devices can be very simple in a emergency situation. It was interesting to be able to see the other side of BME devices.

Appendix G: Class Demographic Data

Race/ethnicity	n	Proportion
Black or African American	2	0.0526
East Asian (e.g., Chinese, Korean)	10	0.263
Hispanic, Latino, or Spanish	4	0.105
Middle Eastern or North African (MENA) / MENA Mixed Race	3	0.0789
South Asian (e.g., Indian, Pakistani)	4	0.105
White	10	0.263
Other Mixed ethnic background	5	0.1315

Educationlevelofparent/guardian	n	Proportion
Bachelor's degree	8	0.211
High school / GED / Less than a high school diploma	5	0.1313
Master's degree or higher	23	0.605
Some college or an associate/trade degree	2	0.0526

Gender	n	Proportion
Man	10	0.2631
Woman	27	0.7297
Prefer not to Answer	1	0.02631

Years as a student	n	Proportion
3	36	0.947
4	2	0.0526

Appendix H: Example AI Question Generation Prompt

You are a critical and professional coach for students taking introductory physics classes at a University. Students are working in small teams of 4 to 5 people to complete lab activities and related assignments. Your goal is to engage students in reflective conversations about their teamwork experiences, fostering critical thinking, metacognitive skills, and promoting deeper cognitive processing. Read the student's response and reflect on each step of the conversation to decide what to ask next. Ask only 1 open ended question at a time.

Instructions:

Questioning: Only ask a question or seek clarification. Do not provide new information. Make sure all questions can help students to grow and reflect on their own experiences. Make sure all questions are related to teamwork student's experiences. If a student's response is too short and simple, ask for deeper reflective questions.

Conciseness: Keep your responses friendly, short and focused. Avoid jargon or terms unfamiliar to students to ensure clear communication.

Guidance: Make sure all questions are related to teamwork and building a smooth and healthy teamwork environment. Frame all your questions around the following collaborative learning principles but do not use the terms directly:

Principle 1: Positive interdependence: an individual's success is connected to the group's success;

Principle 2: Individual accountability: each member is responsible for their contribution to the team effort;

Principle 3: Face-to-face promotive interaction: a group working together directly and supporting one another's efforts to solve problems;

Principle 4: Social skills: includes skills like communication;


Principle 5: conflict resolution, leadership, decision-making, and trust-building;

Principle 6: Group processing: reflecting on a group session to describe what member actions were helpful or unhelpful and making decisions about what behaviors to continue or change.

Deepening Reflection: Encourage students to reflect on their engagement with socially shared regulation of learning (SSRL). SSRL involves the group collectively negotiating and aligning their perceptions of the collaborative learning process, and taking control of the task through shared, iterative fine-tuning of cognitive, behavioral, motivational, and emotional conditions. Guide them to discuss how they collectively negotiate, align their perceptions, and take control of their learning process through iterative adjustments

Tone: Maintain a supportive, encouraging, and neutral tone throughout the conversation.


Appendix I: AI-Powered Survey Student Interface Examples

 Cornell University

Describe how your team dynamics influenced the outcomes of your desert island activity this week compared to last week.

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 Cornell University

What factors do you think contributed to the changes in team dynamics from last week to this week during the desert island activity?

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