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Bridging to an Uncertain Future: Active Learning for Holistic Attitudes in Pre-College Civil Engineering (Evaluation)

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Bridging to an Uncertain Future:

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ABSTRACT

With continuously evolving civil engineering technology and design objectives, developing skills that prepare students for an uncertain future is essential (Evaluation). This work examines the effectiveness of learning activities designed for a one-week summer course with 2 cohorts and 65 students during Summer 2025. The course aimed to *(i)* cultivate holistic attitudes in pre-college students while introducing them to civil engineering and *(ii)* promote an engineering mindset and increase motivation to study civil engineering in college. To achieve these goals, all course activities used engineering context as a platform to develop holistic attitudes, including creativity, adaptability, applicability, and professional skills. However, some course activities focused more on developing holistic attitudes, while others focused more on covering technical content. Students also completed a team final project designing and presenting a bridge connecting two cities. This project highlighted the importance of civil engineering to society, the interdisciplinary nature of the field, and encouraged students to apply their developed holistic attitudes and technical knowledge. To evaluate the success of the course in meeting the established objectives, students answered an anonymous feedback questionnaire and pre- and post-course surveys. Descriptive results suggest gains across all attitudes, strongest for applicability. Wilcoxon tests compared pre- and post-course surveys. Results suggest positive impacts on student confidence in problem-solving and applying learned knowledge. Additionally, the quantitative analysis indicates statistically significant improvement in stated student understanding of civil engineering relevance. On the other hand, the results suggest no statistically significant impact of the course on stated student motivation to practice engineering and to study civil engineering in college. The findings indicate that a compact summer course utilizing active learning components and a team-based project can strengthen holistic attitudes in pre-college learners. Study limitations included the weeklong period with each cohort and only having one iteration of the course. These limited the volume of content that could be covered and did not provide the instructors with the opportunity to improve the course with additional iterations. Future work will focus on increasing civil engineering outreach to pre-college students and developing improved methodologies to better foster student motivation to study civil engineering.

1. INTRODUCTION

As construction technologies and projects advance, and as engineering evolves, professionals are compelled to develop holistic attitudes that are essential for their future careers. This is also relevant for students, particularly in pre-college settings, whose training in technical content can be only a starting point as soon as they enter the job market. For this reason, developing capabilities that prepare students for an uncertain future in civil engineering is essential. These skills, herein referred to as holistic attitudes, are integrated dispositions and competencies that shape how people think, behave, and make decisions in engineering tasks, beyond technical content knowledge. In this vein, developing these attitudes while teaching technical civil engineering content is particularly relevant for pre-college students. Integrating both enables them to understand how technical and attitudinal competencies should be used together to support success throughout their entire career, regardless of field. This study evaluates the effectiveness of a one-week pre-college course designed by civil engineering Ph.D. students at Purdue University in planning active learning components that cultivate holistic attitudes while introducing civil engineering technical content.

This study operationalized holistic attitudes as students' self-reported perceptions that the course supported four transferable, cross-context capabilities relevant to civil engineering learning: *creativity* (generating novel and useful ideas), *adaptability* (transferring knowledge from one scenario to another), *applicability* (use of knowledge in real-world situations), and *professional skills* (communication, teamwork, planning, and social responsibility). Students applied all developed attitudes to a final group project, allowing them to learn the importance of interdisciplinary collaboration in engineering. Evidence of holistic attitudes development was measured using an anonymous feedback survey at the end of the course and pre- and post- course surveys.

To cover a wide range of information, the five Ph.D. student instructors teaching this course represented various civil engineering concentrations including construction, structural, and transportation engineering. Each instructor developed instructional content and activities pertaining to their specialization that used active learning, a method that has been identified in the literature as an effective methodology to prepare students in engineering settings [1], [2]. The course activities were also evaluated in terms of their effectiveness in developing an engineering mindset and engaging students in civil engineering. Experiential learning activities have been reported as an effective tool to increase student interest in STEM [3], [4]. Studies have also examined the influence of pre-college courses in students' interest to apply for engineering majors [5]. In the long term, the students' exposure to pre-college courses in engineering can increase their self-efficacy in the undergraduate program [6], [7], and their persistence in continuing engineering studies [8].

2. COURSE DESCRIPTION

Course planning

The instructors completed approximately seven months of departmental-level teaching training and material preparation. Course planning started with instructors developing course-level learning outcomes to guide the subsequent activity development. The three agreed upon outcomes included that upon completion of the course students should be able to (i) describe the role of civil and construction engineering in the face of contemporary challenges; (ii) list different specializations within civil and construction engineering; and (iii) identify modern technologies to solve civil and construction engineering problems. Outcomes (i) and (iii) emphasized the importance of developing student creativity to enable them to tackle pressing challenges through applying classroom knowledge and information from their prior experiences. Outcome (ii) focused on professional skills, highlighting the importance of communication and teamwork, especially when tackling interdisciplinary problems.

To achieve these course outcomes, instructors researched and implemented educational theories shown to aid in student learning and knowledge retention. The most frequently incorporated theory was active learning, described by Freeman [9] as a method that engages students in the process of learning through activities and/or discussion in class. Studies have long described the importance of a philosophy of experience to improve learning, with a continuous process of doing and reflecting instead of only memorization [10]. In this vein, the method is opposed to passively listening to an expert as it emphasizes high-order thinking and often involves group work [9].

Instructors designed active learning tasks based on recommendations by Felder, Brent, and Oakley [11] incorporating individual, small-group, and think-pair-share exercises. Following Bonwell and Eison [12], the activities were designed with students doing tasks and thinking about what they are doing. All instructors focused on recalling prior material from their previous classes, as well as tying their lessons to information previously presented by other instructors. Connecting the information from different instructors helped with both course continuity across the different disciplines and to develop adaptability by encouraging students to apply knowledge learned in one setting to another. For example, when completing the Bridge avatar and Gantt chart activity (a detailed description of the activities is provided below), students were provided with bridge criteria that integrated bridge superstructure types as covered in the lecture prior to the Spaghetti bridge build, required lane widths based on the provided traffic flow, and the impact of societal preferences as explored during their survey design.

Course schedule and participants

The one-week course had two cohorts in Summer 2025, one at the end of June with 34 participants and another at beginning of July with 31 participants. All the instructors were Ph.D.

students selected in October 2024 for the course. Most of the instructors had prior teaching experience, and some were also pursuing graduate certificates in engineering education.

The weekly schedule was structured to introduce the instructors, course content, and final project on Monday, followed by three days of classes. Friday morning was considered a course review and afternoon was the project presentation in a poster format that was open to the public. The classes started at 8:30 AM and finished around 4:00 PM. The students also had an additional hour to specifically work on their project in a computer lab, supervised by all instructors. To support students' learning and engagement, course structure was complemented by a residential on-campus experience where they had access to campus dining courts for the three meals. During their free time, peer mentors, undergraduate students who served as "camping leaders", organized recreational activities that allowed students to explore the campus and interact with their peers. A simplified program schedule can be found in the Appendix.

The students were between 15 and 17 years old when they participated in the program. Most of them were high school seniors and juniors, with a few being sophomores. Based on instructors' observations, approximately three-quarters of the participants were males. Additionally, most of them were from Indiana, the state where Purdue University is located, and were familiar with the institution. During the program, they reported being interested in college life and the application process, indicating that they intend to apply to college soon.

Activities

The course emphasized active-learning components that supported both the development of holistic attitudes including *adaptability*, *applicability*, *creativity*, and *professional skills*, and technical knowledge related to civil engineering concepts.

Examples of activities that focused on developing holistic attitudes include:

Survey design and data analysis: students designed and distributed a survey to explore how human behavior can influence bridge design, with the goal of developing *adaptability* as a skill. By converting human-centered observations into hypotheses, survey questions, and design implications, students practiced transferring knowledge across contexts (from behavior to engineering decisions), in a similar context as the one applied in transportation studies [13]. Working in groups of three, they first generated hypotheses about behavioral factors affecting bridge planning (e.g., perceived nighttime safety affecting lighting needs, which influences project design) and then created closed-ended questions to assess those hypotheses. An instructor selected approximately 12 student-developed questions (representing the four themes: safety perceptions, accessibility needs & bridge location, travel behavior, and cultural significance) and compiled them into a Google Form for data collection. Since the questions were closed-ended, students also had to anticipate appropriate response options, training their *planning* skills. To ensure the dataset was suitable for analysis, the instructor modified or added questions. On the next day, the students shared the Google form with friends and family members to collect responses and summarize the results in terms of response distributions for discussion and use in the final project, including justifying at least one design decision. The survey collected 353 responses, although due to survey anonymity, duplicate responses may have been recorded.

Vehicle counting: to develop *applicability* and *teamwork*, students first measured traffic flow by conducting a field-based observational survey and recorded vehicular traffic patterns. Later that week, students participated in a learning activity on automating traffic counting, culminating in the comparison of field measurements with modern engineering counting techniques. In the first part of the activity, students worked in two groups formed by alternating count-off and each group was assigned to a survey location. Within each group, four students rotated through specific roles in a three-minute interval: one student served as the reference point for tracking vehicles, one signaled when a vehicle passed, one tallied the count, and one managed timing and provided support. Each group conducted a total of 15 minutes of observation. On another day, an instructor showed how to automate the traffic counting activity using computer vision models in a Google Colab environment.

Debate: on the final day before the project presentation, students participated in a debate on the use of artificial intelligence (AI) in traffic signaling to develop *creativity*, *communication*, and *social responsibility* in a civil engineering context. Students were assigned to three groups: seven served as city council members responsible for voting on whether to adopt the system, while the remaining students were split into two teams that either supported or opposed AI integration. Group assignments were instructor-determined to encourage creative thinking, such as defending positions students may not have initially held. To frame the discussion, students reviewed results from two fictional surveys: one reflecting engineers' perspectives on technical advantages and disadvantages, and another capturing residents' perceptions. Each team delivered an initial three-minute statement, responded to questions from the city council members, and then alternated brief one-minute speeches. The activity concluded with each city council member casting and announcing a vote, providing students practice in public argumentation on a timely, socially relevant issue.

Spaghetti bridge build: to develop *applicability, creativity* and *teamwork* in an engineering context, students were split into small groups and tasked with building the strongest bridge possible out of spaghetti and hot glue with limited time and materials. Each bridge had to meet the following requirements: it resembles a bridge, spans an 8-inch gap, be at least 1-inch wide, rests flat on top of 2 vertical supports, and includes a pencil with a suspended carabiner at midpoint. The carabiner held a bucket for testing, where books were added one at a time until the bridge collapsed. The strongest bridge constructed was able to hold 20.4 pounds before failure. Observing different failure modes led students to discuss load distribution in uneven bridges and the effect of unsupported span length. Students noted, for instance, that the pencils supporting the carabiner broke in some designs but withstood larger loads in others.

Examples of learning activities that focused on covering technical knowledge included:

Bridge Avatar and Gantt Chart: in this activity, students learned basic bridge structural components, their functions, material choices, costs, and construction order, in a simplified, game-based format. This activity consisted of two stages. In the first, referred to as the Bridge Avatar activity, students used mission cards describing site conditions to list structural elements, identify required materials, and determine direct and indirect costs of a generic bridge. Each group selected the pile type, bridge span type, and width based on site conditions. They then selected and placed the corresponding bridge avatar onto their own boards to visualize their design decisions. The second stage of the activity involved scheduling bridge components in the Gantt Chart to help students understand how project duration, cost, and task dependencies influence one another. Based on the information card given, the student-identified components that could be built simultaneously, but construction tasks had to follow a strict order. Students then created a color-coded Gantt chart, with each color representing a structural component, and matching sticky notes to visualize the construction sequence and schedule.

3D Building Information Modeling (BIM): in this activity, students used an intuitive, easy-to-follow three-dimensional tool (Tinkercad) to design their bridge using the Bridge Avatar and Gantt Chart activities. This class was split into two days, with the first day focused on user interfaces and small missions, such as drawing lines and using the copying and pasting components. On the second day, they were asked to build the whole bridge as a team. This activity emphasized students' collaborative design to create individual components and share their parts to finalize an outcome after merging.

Laboratory Tour: to develop students' technical knowledge and broaden their awareness of career options in civil engineering, students toured Bowen Laboratory for Large-Scale Civil Engineering Research. Graduate research assistants actively conducting research at the Bowen Laboratory guided small groups of students through the lab, describing ongoing projects and answering questions. This allowed students to see real-world applications of concepts discussed during engineering classes and learn about active areas of research. Due to instructor experience and work at the lab, students were able to make connections between the instructor research, civil engineering concepts, and tests in the lab.

Project

The multi-disciplinary project integrated the knowledge covered throughout the week of classes into a hands-on team project. The approach was designed to address diverse student interests while introducing technical content at a level appropriate for pre-college students, even though these topics are typically taught in undergraduate courses. To support this approach, the project context described that a hurricane destroyed the bridges connecting campus to the adjacent town. As potential civil engineers, their mission was to design a resilient bridge at one of three locations to withstand future disasters, meet societal needs, and ensure continued connectivity between the cities.

To promote teamwork, students worked in groups of three, with members randomly assigned. The teams were instructed to determine bridge characteristics based on data such as location, specified span, and synthetic traffic data. The data provided varied among groups to enhance variability among the projects. The characteristics that students decided were the number of lanes to accommodate provided traffic flow and design of the bridge, evaluating different bridge types and materials, while also considering budget constraints and users' preferences.

Each day of the week, the teams received a list of deliverables to submit at the end of the evening. These deliverables were worked on during the class and in the computer lab. Instructors evaluated the deliverables and provided written feedback at night, enabling students to reflect on their mistakes and successes the next morning. The purpose of the deliverables was to keep the students on track for their final presentation on Friday, when each group would present their project using a poster to college students, faculty, program sponsors, and friends. These attendees could judge the posters using a rubric that focused on attributes such as communication, organization, audience engagement, and professional delivery. Additionally, the instructors judged the work using another rubric they developed to evaluate the technical content. Some of the items evaluated included the rationale behind the bridge design, considering the number of lanes, materials, and superstructure type, as well as the justification for the decision based on human behavior, for which students were encouraged to use data from the survey they developed.

3. ATTRIBUTES ASSESSMENT AND METHODS

Three main instruments were used to examine the course effectiveness. To assess how the learning activities and final project supported the students in building holistic attitudes and learning technical knowledge during the course, an anonymous survey was administered on the final day of the course. This survey asked the students about how the course helped them develop professional skills, understand real world applications, and their perceptions about the final project. Furthermore, to examine the course's impact on students' confidence in their holistic attitude development and interest in civil engineering, a comparison between pre- and post-course questionnaires containing the same questions was conducted. The pre-course questionnaire was administered at the beginning of the first day of class to assess students' perceptions of their ability to apply what they learn in class, thinking through engineering problems and proposing solutions, their understanding about the relevance of civil engineering to real-world challenges, and their interest in pursuing a career in the field. A post-course survey containing the same questions was administered on the last day of classes to evaluate changes in these perceptions. All the instruments used a 5-point Likert Scale ranging from *Strongly Disagree* (1) to *Strongly Agree* (5) and were based or adapted from [14]. Table 1 summarizes the survey's questions:

Table 1. Survey instruments, assessment items, and constructs measured

Instruments	Questions	Construct
Anonymous Survey (1-5 Likert scale)	Q1- I understand the relevance of the material to real-world challenges	Applicability
	Q2- This course helped me develop professional skills (e.g., written or oral communication, reading computer literacy, teamwork, etc.)	Professional skills
	Q3- This course helped me understand how to apply concepts from one scenario to another	Adaptability
	Q4- This course encouraged creative thinking	Creativity
	Q5- The course taught the relevant content to produce a successful final project	Project alignment
	Q6- The course project allowed me to apply what I learned throughout the week	
	Q7- I was given examples of how to apply course content in the final project	
	Q8- Success in applying the course content to the final project depended on me	Personal agency
Pre and Post-course questionnaire (1-5 Likert scale)	Q9- I can think through an engineering problem and propose solutions	Engineering mindset
	Q10- I usually want to put what I have learned in class into practice	
	Q11- When I follow what I have learned in class, I feel I am capable of putting it to use	
	Q12- I understand the relevance of civil engineering in real-life problems	Perceived relevance of civil engineering
	Q13- I am interested in studying civil engineering in college	Interest in studying civil engineering

A total of 63 students from both cohorts answered all questions and for this reason had their responses analyzed in this study. Two students, one from each cohort, were unable to answer the questions, so their responses were not analyzed.

4. RESULTS

The first four questions of the anonymous survey, conducted at the end of the course, focused specifically on assessing students' perceptions about how the course effectively developed holistic attitudes, such as *applicability* (Q1), *professional skills* (Q2), *adaptability* (Q3), and *creativity* (Q4). Although it is not expected that a one-week course drastically improves these attitudes, the questions were designed to examine if the course was able to support them.

Figure 1 presents the average responses and standard errors for the first four questions in the anonymous survey.

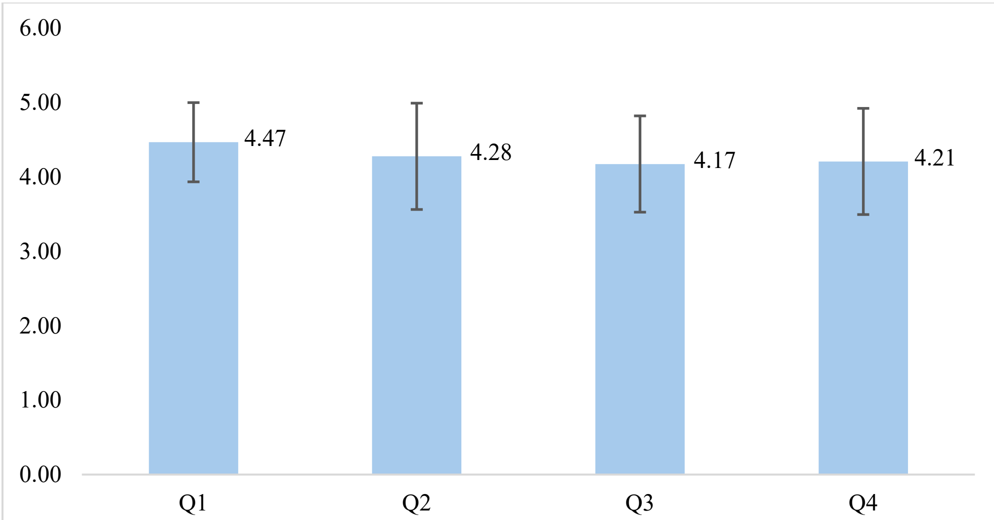

Figure 1. Results of students' responses for questions 1-4

Overall, students perceived the course as effective in developing holistic attitudes, as all survey items had mean responses above 4 (*agree*). As shown in Figure 1, students particularly perceived the course as effective in connecting course content with real-world examples, as question 1 received the highest average score (*4.47*). Activities such as the vehicle counting assignment and the laboratory tour exposed students to real structures and practical challenges that civil engineers commonly face. Question 2 received the second highest average score (*4.28*), reflecting students' perceptions of professional skill development. Many course activities split students into groups, requiring communication and collaboration among team members. For example, the debate activity encouraged interaction and discussion, which contributed to gains in professional skills. Question 3 assessed the students perceived adaptability, which is their ability to transfer knowledge across contexts. Although the average response remained high (*4.17*), it was lower than the other items, highlighting the challenges associated with knowledge transfer, particularly when students are introduced to new or multidisciplinary concepts. Even when a multidisciplinary team delivers instruction, students may still find it difficult to integrate concepts across domains. Similarly, the average response (*4.21*) for question 4 suggests that students perceived the course as effective in fostering creative thinking though activities such as the Spaghetti Bridge build. Given that differences among the mean responses are small, these results are better interpreted as overall trends, rather than as statistically distinct differences across individual items.

The remaining four questions of the anonymous survey focused on the final project, assessing content alignment (Q5-Q7), and personal agency (Q8). Figure 2 presents the average responses and standard errors.

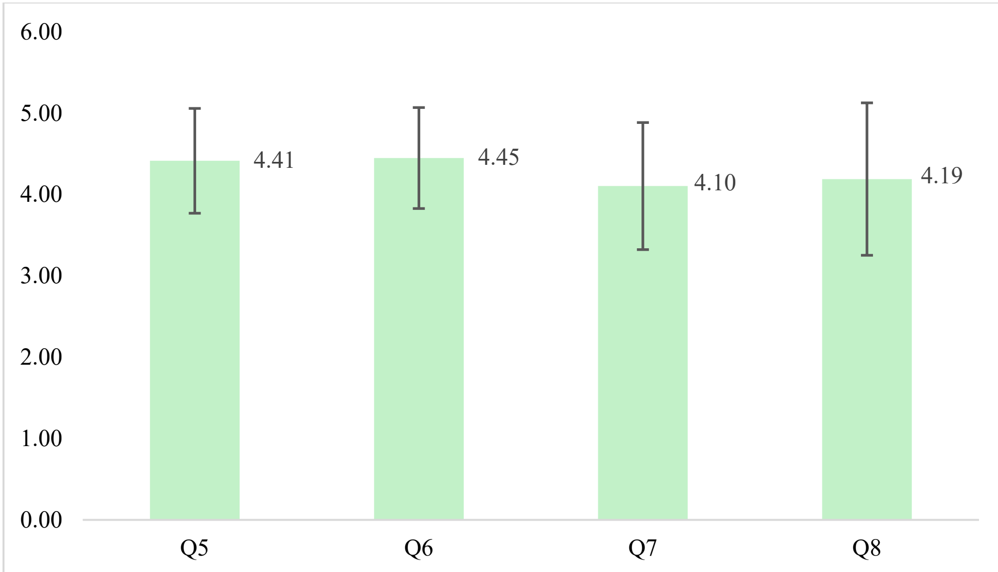

Figure 2. Results of students' responses for questions 5-8

The results suggest that students perceived the final project as well aligned with the course content. The average response for question 5 (*4.41*) indicates that students perceived the course activities adequate for learning the content required to complete the final project. Similarly, responses to question 6 (*4.45*) suggest that students perceived the capstone project as an effective opportunity to apply what they learned during the course. On the other hand, the relatively lower average response for question 7 (*4.10*) suggests that students would have preferred additional examples demonstrating how to apply course content to the final project. This result is reasonable, as project-focused preparatory activities were primarily concentrated within three days of the course schedule. Regarding perceived ownership of applying course content, assessed by question 8 (*4.19*), students generally indicated that successful project outcomes depended on their own efforts and actions.

Regarding the pre- and post-course questionnaire, the first three questions examined students' perceptions of how effectively the course developed an engineering mindset, focusing on engineering problem-solving (Q9), motivation to engage in engineering practice (Q10), and confidence in applying engineering concepts (Q11). The final two questions focused specifically on civil engineering, assessing perceived relevance of the discipline (Q12), and student interest in pursuing a career in the field (Q13). The results of the pre- and post-course questionnaires are presented in Figure 3, where the horizontal and vertical axes represent pre-course and post-course responses, respectively. Each cell displays the number of students who moved from a given pre-course rating to a given post-course rating, with darker shading indicating higher counts. The diagonal represents students who selected the same response in both surveys. Cells above this diagonal indicate improvement (higher post-course ratings), whereas cells below the diagonal indicate a decrease. For example, in question 9, a total of 21 students moved from "Agree" (pre-course) to "Strongly agree" (post-course).

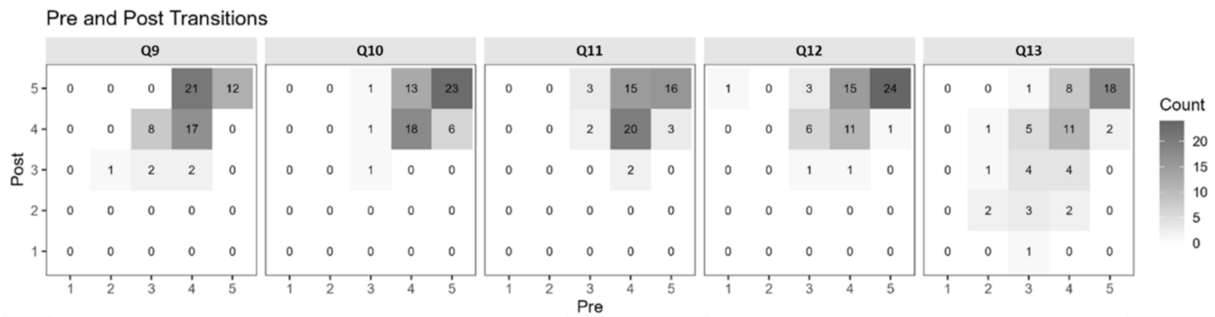

Figure 3. Comparison of pre- and post-course student responses for questions 9-13

Additionally, five paired pre-post Wilcoxon tests were conducted to check whether the participants' perceptions changed significantly after the course. This nonparametric method was selected because responses were measured on a 5-point Likert scale and observations were paired [15]. Holm's correction was applied to adjust the reported p-values for multiple comparisons [16]. Table 2 summarizes the test statistics.

Table 2. Wilcoxon test results of pre- and post-course comparison

Question	Average Pre	Std. dev. Pre	Average Post	Std. dev. Post	p-value
9	4.00	0.64	4.44	0.64	0.000
10	4.41	0.58	4.57	0.53	0.086
11	4.23	0.58	4.52	0.56	0.006
12	4.19	0.81	4.65	0.54	0.000
13	3.97	0.89	4.02	1.08	0.687

Table 2 shows that mean responses increased across all measured dimensions following the course; however, only three changes were statistically significant. Specifically, students reported significant improvements in engineering problem-solving (Q9, $p < 0.001$), confidence in applying engineering concepts (Q11, $p = 0.006$), and understanding the relevance of civil engineering to real-world problems (Q12, $p < 0.001$). These gains are consistent with the course's emphasis on applied activities and with prior research showing that mastery-oriented, context rich instructional approaches enhance self-efficacy and perceived task value through authentic problem-solving experiences [17], [18]. In contrast, the dimensions related to future aspirations such as motivation toward engineering practice in general (Q10, $p = 0.086$) and interest in pursuing a career in civil engineering (Q13, $p = 0.687$), did not show statistically significant changes. Prior work suggests that career intentions are shaped by longer-term identity development, social influences, and cumulative academic and social experiences rather than single course interventions, which may enhance competence and perceived relevance without immediately altering established career trajectories [18], [19]. This likely contributes to the limited short-term change observed in these future-oriented outcomes.

5. CONCLUSIONS AND FUTURE WORK

Overall, the results indicate that students perceived the course as effective in developing holistic attitudes through its activities. The course content was also evaluated as well-aligned with the final project, which integrated holistic attitudes with the technical material covered during the week. In addition, students reported that the curriculum contributed to the development of an engineering mindset. On the other hand, only moderate effects were observed in motivating students to pursue an engineering major. With respect to civil engineering specifically, a dual pattern emerged. While the course improved students' understanding of the relevance of civil engineering to society, it did not significantly increase their motivation to pursue a degree in the field.

This study indicates that even brief, experiential programs such as summer camps can contribute to the development of holistic attitudes in pre-college students. For participants who later enter engineering majors, particularly civil engineering, early exposure to authentic, hands-on tasks may provide more than introductory technical familiarity. It can also strengthen transferable attitudes, such as communication, adaptability, and responsible decision-making that remain valuable across courses, projects, and professional roles as engineering practice continues to evolve.

At the same time, the short duration of the program imposes clear limits on the depth and durability of these outcomes. A single week offers restricted time for repeated practice, feedback, and reflection, which are typically required for sustained growth in holistic attitudes. Accordingly, short-format camps should be considered as a reinforcing experience rather than a primary pathway for developing these competencies. Development of holistic attitudes should also be supported through students' regular school curricula and extracurricular opportunities over longer time periods.

Future iterations of the course will expand the portfolio of activities to target additional holistic attitudes not emphasized previously, including leadership, critical thinking, and ethical reasoning. Revised versions of the course will also explicitly incentivize the students' interest in pursuing engineering majors, given that the current course design did not consistently increase students' motivation to pursue majors in civil engineering. From a research perspective, the study is limited by its reliance on student self-assessments to measure changes in holistic attitudes. Subsequent work should incorporate independent, third-party measures, such as performance-based assessments administered before and after the intervention, enabling comparisons between students' reported growth and demonstrated behaviors. Finally, to better assess longer-term impacts on engineering identity and career direction, follow-up data should be collected in future years to determine students' eventual enrollment choices. Such long-term tracking would allow the study to distinguish stated intentions from revealed decisions regarding major selection.

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APPENDIX

Figure A.1. Simplified program schedule

<table>
<tr><th></th><th>Monday</th><th>Tuesday</th><th>Wednesday</th><th>Thursday</th><th>Friday</th></tr>
<tr><td>7:15 AM - 7:30 AM</td><td rowspan="4">Breakfast</td><td rowspan="4">Breakfast</td><td rowspan="4">Breakfast</td><td rowspan="4">Breakfast</td><td rowspan="4">Breakfast</td></tr>
<tr><td>7:30 AM - 7:45 AM</td></tr>
<tr><td>7:45 AM - 8:00 AM</td></tr>
<tr><td>8:00 AM - 8:15 AM</td></tr>
<tr><td>8:15 AM - 8:30 AM</td><td>Walk to class</td><td>Walk to class</td><td>Walk to class</td><td>Walk to class</td><td>Walk to class</td></tr>
<tr><td>8:30 AM - 8:45 AM</td><td rowspan="3">Course introduction</td><td rowspan="7">Fundamental concepts of transportation enginnering</td><td rowspan="2">Tour Instructions</td><td rowspan="4">Stakeholders on civil and construction engineering</td><td rowspan="4">Institutional presentation</td></tr>
<tr><td>8:45 AM - 9:00 AM</td></tr>
<tr><td>9:00 AM - 9:15 AM</td><td rowspan="2">Transportation</td></tr>
<tr><td>9:15 AM - 9:30 AM</td><td rowspan="3">Instructors introduction</td></tr>
<tr><td>9:30 AM - 9:45 AM</td><td rowspan="3">Vehicle counting field trip</td><td rowspan="4">Civil and construction engineering materials Part 2</td><td rowspan="4">Review of the week</td></tr>
<tr><td>9:45 AM - 10:00 AM</td></tr>
<tr><td>10:00 AM - 10:15 AM</td><td rowspan="3">Students introduction</td></tr>
<tr><td>10:15 AM - 10:30 AM</td><td rowspan="7">Introduction to bridge design</td><td rowspan="5">Laboratory Tour</td></tr>
<tr><td>10:30 AM - 10:45 AM</td><td rowspan="6">Collaboration among civil and construction engineering disciplines</td><td rowspan="2">Walking Tour</td></tr>
<tr><td>10:45 AM - 11:00 AM</td><td rowspan="3">Project introduction</td></tr>
<tr><td>11:00 AM - 11:15 AM</td><td rowspan="4">Presentation Practice</td></tr>
<tr><td>11:15 AM - 11:30 AM</td></tr>
<tr><td>11:30 AM - 11:45 AM</td><td rowspan="2">Ice breaker 1</td><td rowspan="2">Transportation</td></tr>
<tr><td>11:45 AM - 12:00 PM</td></tr>
<tr><td>12:00 PM - 12:15 PM</td><td>Walk to Lunch</td><td>Walk to Lunch</td><td>Walk to Lunch</td><td>Walk to Lunch</td><td>Walk to Lunch</td></tr>
<tr><td>12:15 PM - 12:30 PM</td><td rowspan="4">Lunch</td><td rowspan="4">Lunch</td><td rowspan="4">Lunch</td><td rowspan="4">Lunch</td><td rowspan="4">Lunch</td></tr>
<tr><td>12:30 PM - 12:45 PM</td></tr>
<tr><td>12:45 PM - 1:00 PM</td></tr>
<tr><td>1:00 PM - 1:15 PM</td></tr>
<tr><td>1:15 PM - 1:30 PM</td><td>Walk from lunch</td><td>Walk from lunch</td><td>Walk from lunch</td><td>Walk from lunch</td><td>Walk from lunch</td></tr>
<tr><td>1:30 PM - 1:45 PM</td><td rowspan="5">Ice breaker 2</td><td rowspan="5">Introduction to bridge components</td><td rowspan="6">Civil and construction engineering materials Part 1</td><td rowspan="6">Introduction to automated data collection</td><td rowspan="5">Project Presentations</td></tr>
<tr><td>1:45 PM - 2:00 PM</td></tr>
<tr><td>2:00 PM - 2:15 PM</td></tr>
<tr><td>2:15 PM - 2:30 PM</td></tr>
<tr><td>2:30 PM - 2:45 PM</td></tr>
<tr><td>2:45 PM - 3:00 PM</td><td rowspan="5">Human behavior affecting civil and construction engineering projects</td><td rowspan="3">Introduction to construction management principles</td><td rowspan="2">Final Class Activities</td></tr>
<tr><td>3:00 PM - 3:15 PM</td><td rowspan="5">Data analysis in civil and construction engineering</td><td rowspan="9">Computer lab</td></tr>
<tr><td>3:15 PM - 3:30 PM</td><td rowspan="8"></td></tr>
<tr><td>3:30 PM - 3:45 PM</td><td rowspan="3">3D Building Information Modeling Part 2</td></tr>
<tr><td>3:45 PM - 4:00 PM</td></tr>
<tr><td>4:00 PM - 4:15 PM</td><td rowspan="3">3D Building Information Modeling Part 1</td></tr>
<tr><td>4:15 PM - 4:30 PM</td><td rowspan="4">Computer lab</td><td rowspan="4">Computer lab</td></tr>
<tr><td>4:30 PM - 4:45 PM</td></tr>
<tr><td>4:45 PM - 5:00 PM</td><td rowspan="2">Material delivery and photos</td></tr>
<tr><td>5:00 PM - 5:15 PM</td></tr>
</table>

Activities	Survey design and data analysis	Spaghetti bridge build	Debate
	Vehicle counting	Bridge Avatar and Gantt Chart	Laboratory tour
	3D Building Information Modeling	Project preparation	Project Presentation