PROJECT-BASED LEARNING FOR ENHANCING STUDENTS' KNOWLEDGE ON ACTIVE COMMUTING: A REVIEW FROM STUDENT SELF-ASSESSMENT

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The use of active-based learning techniques in classroom instruction can be an effective pedagogical strategy to facilitate student learning. Engaging students in real world applications of complex engineering concepts will likely cause higher levels of learning to occur. This paper presents student assessments and feedback for one project-based active-based learning intervention, which is designed to expose students to two distinct concepts (physical activity and safety) associated with active transportation. The project was incorporated into a junior-level transportation engineering course. This project intervention consists of two phases: 1) inventory of infrastructure elements near a school, 2) real time use and safety assessment (conflict analysis). This paper considers student self-assessments of learning achievement from the different phases of the intervention and overall satisfaction with this instructional strategy and compares these assessments with their scores in pretest-posttest and project report.

The surveys use a set of eleven questions. These questions cover each project phase overall and the tasks within each phase. Sample questions:

- Do students think that the teaching materials provided at the beginning of the intervention help them perform phase I efficiently and effectively?
- Do they learn adequate information on elements of transportation infrastructure related to physical activity?
- Do they think that meeting with the course convener in a one-on-one session helped them perform better?

These questions are designed using a five point Likert scale, and Figure 1 presents the mean responses for each question.

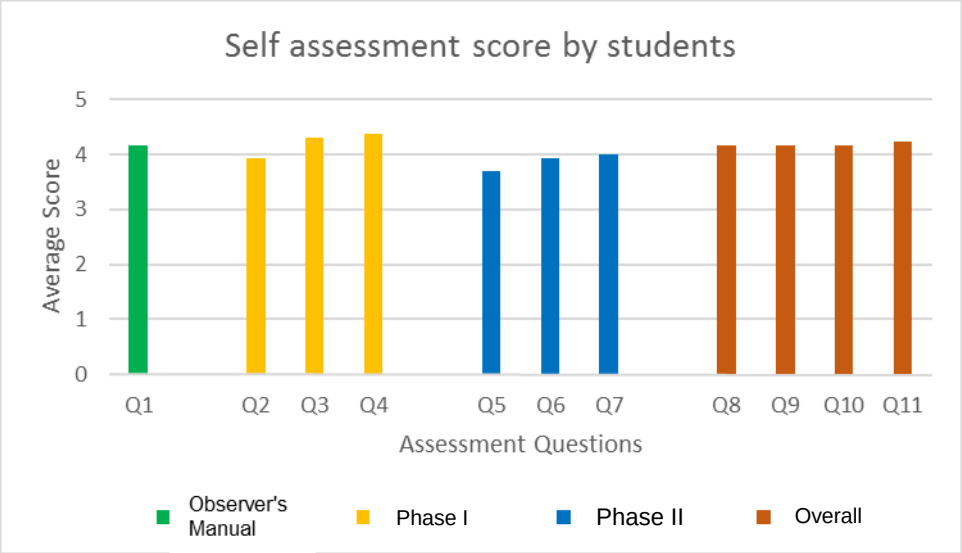

Figure 1. Relationship between self-assessment average score and related project phases

Quality of Instructional Materials. At the beginning of the course students were provided with an observer's manual to introduce them to the key concepts. Question one asks students about the "observer's manual's" contribution to their learning of various infrastructure elements related to safety and physical activity. Using a comprehensive literature review, the research team designs the manual, which has two different sections for physical activity and safety. These manuals define the infrastructure elements that may have a positive or negative impact on active transportation. The major goal of the manuals is to assist students while they collect inventory data in phase I. Overall, the students believe (over 84% of the students *agree* or *strongly agree*) that the manual contributed to their learning; furthermore, eighty percent of those who perform better on the posttest agree or strongly agree that the observer's manual contributes to their learning.

Phase 1: Identifying Active Transportation Infrastructure Elements. In phase 1, students were introduced to a variety of infrastructure elements related to active commuting. Students were asked three questions to evaluate whether or not exposure to these elements in the field improved learning. Only seventy-seven percent of the students *agree* or *strongly agree* that the materials supplied in phase I helped them in the field to complete it accurately without any challenges. Almost thirty percent of the students *strongly agree* that phase I contributes to their knowledge of active transportation infrastructure elements that encourage/discourage walking/biking for physical activity, and about forty percent *strongly agree* that phase I contributes to their knowledge of safety elements. The students believe that phase I has a modestly larger impact on student

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learning than phase II. The qualitative assessment of the students cannot alone highlight any positive or negative impact of different phases of the intervention; but a connection between the qualitative assessment and the student self-assessment can strengthen the claims. A comparison of students' performances on their phase I project submittal with survey questions related to phase I (question two) shows that while seventy-seven percent of the students *agree* or *strongly agree* that the project materials provided at the beginning of the project help them in their learning process, ninety percent of them completed phase I with B or better work.

Phase II: Data Collection in the Field. Phase II required students to submit a conflict analysis report form, a queue data collection form, and a final project report. Several questions ask students to evaluate if Phase 1 prepared them for Phase II. Almost half of the students indicate that the initial survey has a neutral impact on performing data collection and reporting in phase II; however, over 45% of the remaining students believe that is has a positive impact. When considering all of the questions, the students show less enthusiasm for the impact of phase II (on both safety and physical activity infrastructure elements) even though their overall support remains high (almost 70% positive response). Overall, the students indicate that more guidance and support may improve their experience with phase II. The average score of student self-assessment for phase II is lower than the average score of phase I self-assessment. This trend is also evident when they are compared with their submission scores. Approximately seventy-six percent of the students agree or *strongly agree* that phase II helps them in their field work and more than eighty percent of these have achieved a B or higher in their phase II submittal.

Overall Learning Experience. Finally, students were asked to evaluate their overall learning experience. Approximately 85% of the students *strongly agree* that their knowledge of transportation infrastructure elements related to safety/physical activity of walking/biking improved significantly. More than 90% of the students are willing to see more project-based learning intervention in their future course. One-on-one review with the course convener shows a higher level of satisfaction as more than 90% students either *strongly agree* or *agree* that it helped them finish the project efficiently and effectively. The overall performance of students in phase one in both cases (self-assessment and submittal scores) are higher than phase II. At the end, 92% of students agree or strongly agree that the overall intervention process helps them perform better and learn more, almost 100% of them have achieved a B or better in their final project submission. Additional evaluation of the improvement of the pre-and posttest scores with the overall self-assessment illustrates that more than seventy percent of the students who scored better in the posttest than pretest agree or strongly agree that the intervention helps them gain significant knowledge.

Future research should perform a detailed statistical analysis to directly compare individual student performance on pre- and post-test with self-assessment to validate the link between self-efficacy and performance. The researchers also need to review the pre-/post-test questions to assess their effectiveness in measuring student learning and their linkage with the intended objectives. The current research design, which uses pre- and post-tests, represents a simple and cost-effective instrument to assess the intervention, but other options such as pre- and post-scenario exposures should be considered and validated. The level of exposure that students have to particular concepts at the onset of the course and project-based learning intervention's grade importance may influence learning outcomes. So, instructors may wish to design project-based learning to ensure that it enhances students' preexisting knowledge. Finally, instructors must ensure that students receive adequate exposure to all course concepts through the project.

The student performance on the post-test supports that student learning occurs over the physical activity elements. This does not completely agree with the self-efficacy assessments with respect to the impact of the project; however, the self-efficacy assessments match with the overall performance level on the post-test. This project based learning intervention appears to have some success on improving student knowledge of active transportation. This intervention will be repeated in future semesters to increase the sample size of the effected students.