
AC 2011-1476: CONNECTING STUDENT EXPERIENCES WITH CONCEPTS AND PRINCIPLES OF FLUID MECHANICS

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Connecting Student Experiences with Concepts, Principles, and Methods of Fluid Mechanics

This paper presents results from the introduction in fall 2010 of an innovative assignment into a traditional fluid mechanics course. The new assignment built on students' work experiences, observations of the natural and built environment, current events, and curiosity and is called the App, named specifically as a spin on the many apps that are available for smart phones.

For the assignment titled CEE310 App: Real-world Application of Fluid Mechanics Concept, students begin with their experience, observation, or curiosity and work in pairs to demonstrate their understanding of a fluid mechanics concept introduced in class. This assignment has four parts: (1) identify and research an example that relates to a fluid mechanics concept;(2) design and deliver a presentation; (3) review feedback and revise slides; and (4) write and post a reflection. This assignment enables students to

- Demonstrate their understanding of a specific fluid mechanics concept;
- Apply a specific fluid mechanics concept to a real-world situation;
- Communicate their application in a clear, concise manner to their peers;
- Design visuals to accurately demonstrate a concept;
- Provide and accept constructive criticism; and
- Reflect on their learning.

The App was introduced in fall 2010 to improve both instructor teaching and student learning and to connect learning outcomes more explicitly with engineering practice. The App integrated the core principles of effective teaching and learning with research about developing the skills, values, and ways of thinking of professional engineers, their epistemic frame. Though the App was the innovative component, the course structure was anchored in strategies and methods to provide a positive learning environment. Interaction among instructors and students was both formal and informal. While the App was specific to this fluid mechanics course, it is adaptable to any course within any profession. The App and re-structured course led to improvements in the instructor's teaching evaluations, and by extension, we believe to improvements in the students' learning although the latter is more difficult to document and would be more evident from performance in future dependent courses and professional practice. Evaluation methods included early and mid-semester assessments, end-of-course evaluations and a survey about student perceptions of their learning and what helped them learn. Results show that the App is effective in helping students learn fluid mechanics concepts, communication skills, and small group interactions. As such knowledge, skills, and attitudes connect fluid mechanics and engineering practice, the App is worthy of continued use and refinement.

Background

The fluid mechanics course, CEE 310 at the University of Wisconsin – Madison (UW), is a 3 credit, required course for all Civil & Environmental Engineering (CEE) undergraduate students. Though solid mechanics courses are taught in the Engineering Mechanics (EM) Department, the CEE Department initiated the fluid mechanics course, as the principles of hydraulics were needed in the curriculum and no one was available to teach this course in the EM Department.

Fluid mechanics courses are also offered in the Mechanical Engineering (ME) and the Chemical & Biological Engineering (CBE) Departments.

As a basic, introductory course to the phenomena, concepts, principles and methods of fluid flow, CEE 310 is organized with two lectures and one two hour discussion/lab each week, three exams, weekly homework and quizzes, and laboratory experiments. After defining and illustrating the nature and properties of fluids, the concepts and principles of fluid statics, kinematics, and dynamics are developed and applied to various problems. In particular, mass, momentum, and energy conservation laws are derived and used to predict fluid behavior at integrated (finite volume) scales (e.g., reservoir filling/draining, engine thrust, machine power) and at point (differential) scales (e.g., velocity variation in a vortex, pressure variation around moving object, shear stress/drag on objects) that involve real and ideal fluids. Phenomena described and explained include buoyancy, pressure waves, cavitation, fluid deformations, boundary layers and separation, turbulence, drag and lift. Dimensional analysis and similitude are applied to design experiments and correlate data. Exams cover material presented in the first, second and final thirds of the course. Weekly homework helps develop understanding and provide practice with the material covered in that week. Quizzes cover the lecture and homework material from the previous week. Laboratory experiments are simple, hands-on experiences that small groups of students conduct and analyze to apply concepts and principles covered in lecture.

Though the traditional lecture/laboratory/discussion format allowed the appropriate material to be introduced, explained, and tested to meet curricular requirements, student interest in and awareness of the importance of the subject had declined over the years, evidenced in end of semester student evaluations and enrollment in elective, follow-up courses. Various techniques (e.g., lecture format, laboratory/discussion participation) are available to motivate and engage students in the subject and its importance in civil engineering, as described by Karl Smith and others in *Pedagogies of Engagement*.¹ Changes in CEE310 have included lecture format and laboratory/discussion participation. The App was introduced in fall 2010 to improve both instructor teaching and student learning and to connect learning outcomes more explicitly with engineering practice.

From the perspective of two former students, CEE 310 is a challenging course because of the abstract nature of the material. One of the most beneficial sections of the course is the lab section, in which the students and teaching assistant (TA) perform and discuss experiments. These experiments gave a more conceptual understanding of material and allowed students to visualize phenomena and reconcile it with the complex mathematical equations learned in lecture. Missing in the class was a sufficient link between lecture material and its relationship to fluids in everyday life. Further, as homework, quiz, and experiments were done in the lab/discussion section, there was limited time to discuss course material.

The fall 2010 class had 47 students, although only 40 students responded to the surveys described in this paper. Of these 40 students, 33 were male and 7 were female. The study set consisted of 25 third-year (junior) students, 11 fourth-year (senior) students, 3 fifth-year senior students and one graduate student.

Literature Review

As a foundation course in engineering, fluid mechanics has long been the focus of improvement efforts from the perspective of both effective teaching and student learning. Within the last decade, fluid mechanics concepts have been identified and used as part of concept inventory (CI) assessment instruments, modeled after the force concept inventory instrument designed by Hestenes and Halloun.² Led by engineering educators within the Foundation Coalition,³ other subjects/courses have had CI instruments created. By 2004, Martin, Mitchell, and Newell at the University of Wisconsin – Madison, were evaluating the reliability of the fluid mechanics concept inventory (FMCI) developed cooperatively with engineering faculty at the University of Illinois, Champaign-Urbana.⁴ In 2005, they used technology to assess students' understanding of fluid mechanics concepts and improve student learning.⁵

In 2008, Russell at the University of Hertfordshire described his work with an alternative approach of using weekly assessed tutorial sheets for fluid mechanics and thermodynamics.⁶ Russell and others base their work on the research that shows students learn from good assessment and feedback strategies. Effective assessment can show faculty where students have misconceptions and faculty follow-up can help students understand their misconceptions and the concepts accurately. However, as Russell noted, students still were identifying the importance of grades in driving their effort. In 2009, Martin, Mitchell, Courter, and Welter summarized improvements in teaching fluid mechanics concepts and described their collaborative efforts with Wiley Publishers to design, implement, and assess electronic concept questions which could be used for self-assessment, formative assessment, or summative assessment.⁷ They concluded that CI-type assessment methods are a convenient and logical means of providing feedback on student learning. In 2009, Luo, Qi, and Zhou at the University of South China, documented the importance of multimedia in modern fluid mechanics teaching.⁸ Multimedia modules for fluid mechanics are being developed at the University of Wisconsin – Madison and around the world.

To help students learn the concepts and apply them to real-world problems, faculty need to design modules using what we have learned about CI and misconceptions, how people learn, and effective teaching practices including problem-based learning,¹ technology-enhanced strategies,⁹ and instructional design principles.¹⁰ The study of cognitive science has contributed immensely in the last decade to educators' understanding of how people learn. How People Learn,¹¹ published in 2000 by the National Academy of Sciences, catapulted the energies of educators including engineering educators to improve how we teach. From this work, three learning principles that have profound implications for teaching and engineering education are (1) teachers must draw out and work with the preexisting understandings that their students bring with them, (2) teachers must teach some subject matter in depth, providing many examples in which the same concept is at work and providing a firm foundation of factual knowledge, and (3) teaching of meta-cognitive skills (self-reflection strategies) should be integrated into the curriculum. Finally, technology-enhanced strategies and instructional design principles should be incorporated into teaching practices.

New Approach

a) Learning outcomes – aligning lectures, homework, labs, quizzes, exams

With the introduction of the new App assignment to an already busy course schedule, alignment of all course components and seamless integration of the additional assignment were crucial. These components included lectures, laboratory experiments, homework problems, quizzes, and App. To align the material in the course, end-of-week meetings were held to discuss learning outcomes and concepts that were presented the previous week and topics that would be covered the following week. This practice provided flexibility in scheduling laboratory experiments to ensure all material was interconnected and well integrated. For example, a syllabus with lecture topics and their respective lecture date was provided at the start of the semester; however, certain topics required additional or less time than originally scheduled. As a result, the lab experiments were aligned with the most recent material from lecture.

Learning outcomes were also emphasized in both lecture and lab. In lecture, the learning outcomes of each period were explicitly discussed by the professor and stated on topic handouts given in lecture. The direct nature of this approach provided students with very clear expectations. Ultimately, these daily learning outcomes were sub-topics of the departmental course objectives listed on both the syllabus and the department's course website.

In addition to the material presented in lecture and lab, student homework, quizzes and Apps required proper alignment and scheduling. Three, two-hour exams were given throughout the semester. In between, weekly homework was assigned, and weekly quizzes were taken in the lab sections. Homework assignments followed the material that was presented in lecture and lab. Quiz topics followed the submission of homework assignments, and their respective solution keys. The lag in quiz taking times was necessary so that all relevant quiz information could be presented for studying purposes. The weekly quizzes assessed the students' comprehension of learning outcomes between exams. This allowed the instructors to target subject areas that needed more explanation, while they also provided additional feedback for students.

Finally, lab sections provided time for the App presentations. These presentations began in the fifth week of class in a sixteen week semester. The lag was necessary to introduce basic fluid concepts, and provide students time to research and prepare their apps. Nevertheless, students were persuaded to choose topics early in the semester so that a schedule of groups and their respective topics were posted during the fifth week of class. Organization of the App topics was important to ensure that Apps were concurrent with material being presented in lecture and lab.

b) Tutoring support

The UW College of Engineering Undergraduate Learning Center provides free tutoring service for students enrolled in engineering courses. Tutoring is done by upper-class undergraduate students who have excelled in the particular course they are assigned. The Undergraduate Learning Center provides three main academic support programs: Supplemental instruction, a peer-led, problem-solving workshop that targets difficult courses; Drop-in Tutoring, a service for all students to attend scheduled tutoring sessions and get support in completing homework and

preparing for exams; and Tutoring by Request, one-on-one tutoring for underrepresented students groups in engineering. For the fall 2010 semester, drop-in tutoring was available for CEE 310 students on Tuesday evenings from 6:30 pm to 9:00 pm. Tutoring was held on the engineering campus.

At the end of the semester, students who used the drop-in tutoring program all passed the course with an average to above average grade. In the survey conducted at the end of the semester, 12 students that attended drop-in tutoring commented on how tutoring facilitated their learning of fluid mechanic principles. Eight responded that tutoring was either “very beneficial” or “beneficial” to their learning. To make tutoring service better at meeting students’ needs, some students suggested that tutoring should be scheduled to better align with homework due dates. Furthermore, to increase tutoring turnout and involvement it would be beneficial to have the tutor go to class on the first day to introduce him- or herself and to volunteer and help manage lab one or more times throughout the semester. The most beneficial aspect of tutoring is the better connection between teaching and learning. Tutors are invited to attend the course teaching staff weekly meeting, and are able to report their observations on student learning challenges. This helps the course instructor and teaching assistants tailor students’ learning needs in lectures and discussions. It also helps to align teaching and learning objectives, and significantly improves students’ learning qualities.

c) New assignment

The new App assignment was introduced in the fall 2010 semester with the purposes of (1) deepening students’ knowledge of fluid mechanics principles, and (2) encouraging them to research the ways in which those principles govern the world around them from common (air travel) to highly specialized applications (super-fluids). Students worked with a partner, most choosing their own partner. Each pair then chose a topic, usually accomplished by (1) taking a classroom concept and researching its applications, or (2) researching a phenomena of interest and working backwards to find the fluid mechanics principles that govern it. Each group’s topic was presented to and approved by the group’s TA. After researching the chosen concept, groups built a presentation using Microsoft Office’s PowerPoint to teach classmates about what the students in that group had learned. Common components of the presentations included an overview of the chosen real-world application topic under investigation, an explanation of how it related to a fluid mechanics principle, and a sample problem to solidify the connection between the two. Each presentation was designed to run five minutes with extra time for questions from students and the TA. During the talks, students in the audience and the TA completed evaluation forms. The student evaluations were given to the presenting group as feedback, while the TA assessments were kept for grading. Additionally, presentations were videotaped. Following its presentation, each group was required to read over the evaluations, watch their presentation on videotape, and write a reflection essay on (1) evaluations, (2) their experiences doing the project, and (3) their thoughts on the assignment. This essay was posted with a copy of the group’s Power Point slides (with any identified errors corrected) on the course website for other students to see. Finally, the TAs selected the best presentation between all of the sections each week. The “winners” were then asked to present their project in the lecture in the week following their lab presentation. See Appendix 1 for App assignment and assessment.

In addition to increasing students' knowledge of fluid mechanics, the project was designed to improve other skills important in engineering practice, such as teamwork and communication. Students were asked to work in small groups. Given the reliance of many engineering projects on small or large teams, the project helped prepare them for careers in engineering. Additionally, the presentation format, as opposed to a traditional written report, helped students practice communication skills, especially public speaking. The open question section tested students' abilities to think and answer questions on their feet. However, the small laboratory audience offered a comfortable and supportive setting for the presentation. Overall, the application project improved students' fluid mechanics knowledge as well as their mastery of skills that will allow them to succeed in engineering careers of all types.

To provide an example of the components of the new App assignment, a student who took this course in fall 2009, prepared, presented, and revised slides that described her 2010 summer internship experience working on a cavitation problem in a piping system in a waste water treatment facility for a meat packing plant. This example App was presented during the second week of the semester to familiarize them with their instructors' expectations. In the presentation, an overview of the internship experience was given and followed with a description of the step-by-step process performed by the utility system. Some of the valves were poorly maintained and experienced cavitation. A computer-drawn graphic and several equations were used to explain the cavitation phenomenon in the valves. Finally, several solutions were proposed for the cavitation problem.

The presentation was given to the full CEE 310 class during lecture. Students completed critiques identical to the ones that would be used to grade their presentations. The critiques were used to modify and improve the presentation and write a reflection on the overall presentation. The former student found the exercise to be very helpful in understanding the phenomenon, and applying the concepts to a concrete situation provided a fuller grasp of the phenomena that were only vaguely understood as a student in CEE 310.

Example of App

An example of a typical App was the presentation titled "The Magnus Effect and the Spinning Ball Spiral." This particular student group decided on the topic as a result of their curiosity about why balls curve in various sports such as golf, soccer and baseball. To begin their presentation, the students explained why they chose their topic, and then showed a video of a famous soccer goal that was made possible by the Magnus effect. Next, the students explained how this phenomenon can be described using fluid mechanics principles learned in class. These principles included the Bernoulli equation, dimensional analysis and real fluid flow. To finish their presentation, the students discussed whether gravity or drag forces were the dominant force dictating ball flight patterns, and the resulting magnitude of the Magnus effect.

Student evaluations of this App were all very positive. As with most of the Apps, peer explanations of these complicated fluid mechanics topics helped them understand concepts from someone at their own knowledge level. Furthermore, the students that presented this App indicated on their reflection that:

“The part we enjoyed most was the ability of people to relate and understand the topic and its application to sports.”

The group also appreciated the opportunity to “apply the fundamentals of fluid mechanics that we are learning in the classroom to real world problems.” Designing and implementing this App assignment addressed the teaching goal of creating a more explicit connection between the course topics and real world situations.

Assessment Analysis and Findings

Though the App was the innovative component, the course structure was anchored in strategies to provide a positive learning environment. Frequent assessments, one of the strategies, provided insights into student perspectives and led to improvements within the semester. Informal early semester and mid-semester assessments were developed and distributed by the course instructor with input from the TAs and course tutor. An end-of-semester assessment was conducted formally using Qualtrics assessment software.¹² Figure 1 shows the improvements in students’ perceptions about their learning related to four course components: concepts and principles, application of concepts, homework, and quizzes from early to mid-semester.

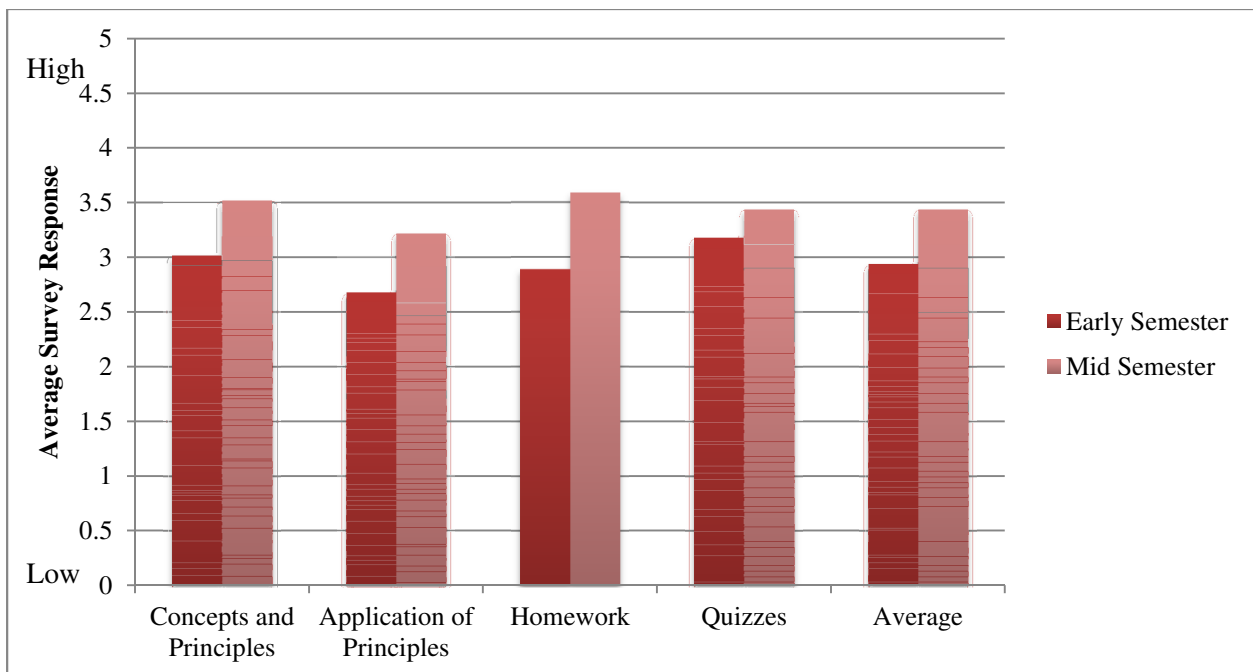


Figure 1. Student responses on informal assessments show demonstrated improvements in four key course components.

From the first assessment, before the first exam, results showed: (1) a need for more examples in lecture and restructuring of laboratory experiments; and (2) moderate learning of concepts and principles, ability to apply these principles, clarification of text and lecture by homework. Students rated the connections between lectures, homework, quizzes and labs at 2.88 on a scale of 1 (low) to 5 (high). The second assessment, before the second exam, showed: (1) an increase from 2.88 to 3.44 on scale of 1 (low) to 5 (high) in learning of concepts and principles, ability to apply these principles, clarification of text and lecture by homework, and connections among lecture, homework, quizzes, and labs; (2) the App strongly, 4 on scale of 1(low) to5 (high), helped learning concepts, principles, phenomena, and applications; and (3) a strong perception, 4 on scale of 1(low) to5 (high), of sufficient examples in lecture and of restructuring laboratory/discussion period and relation of experiments to fluid concepts, principles, and phenomena.

The App assessments, evaluations and reflections showed a general student appreciation for the project. The student evaluations of the App almost universally indicated that they (1) enjoyed watching the App presentations, and (2) felt that all presentations given were strong, informative and entertaining. The visuals included in the presentation were the most commonly praised component. Many students commented that the pictures clarified concepts that they had previously found confusing in a theoretical explanation in class) and in an applied concept. Some students suggested that it was helpful to hear explanations of challenging concepts from their peers. The most common criticism was for the students' public speaking skills. However, nearly all of the App reviews ranked the topics chosen as interesting, and students verbally expressed their like of the Apps in lab.

When asked mid-semester whether or not the App was helping them learn/understand concepts, principles, phenomena, and applications of fluid mechanics, over 80% of the students responded "yes." When asked at the end of the semester to rank how well six course components helped them connect their experiences, observations, or interests to fluid mechanics, personal and other students' App presentations were ranked second and third (Figure 2). When asked to rate on a scale of 1 (low) to 5 (high) how much twelve course components helped them learn, the App, at 2.75, is in the middle of the group, while homework, text, tutor and office hours were above 3.00 (Figure 3).

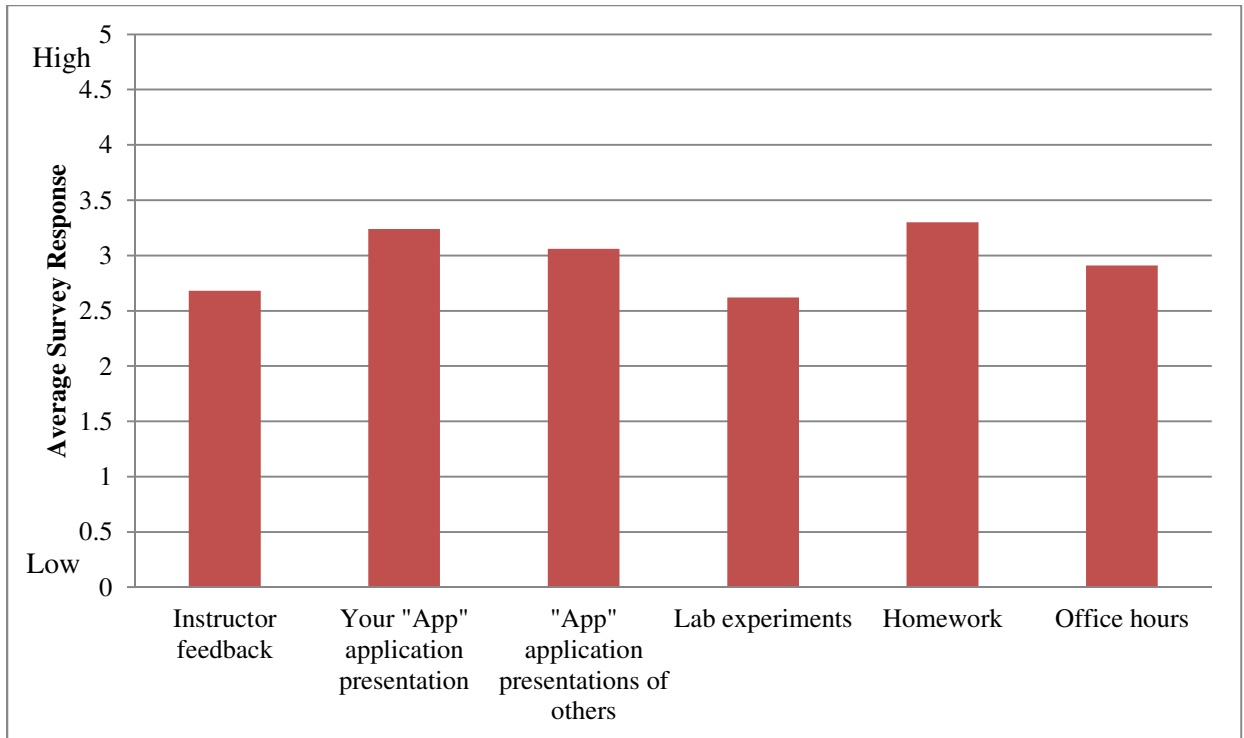


Figure 2. Students **ranked** the usefulness of six course components in helping them to connect experiences, observations and interests to fluid mechanics.

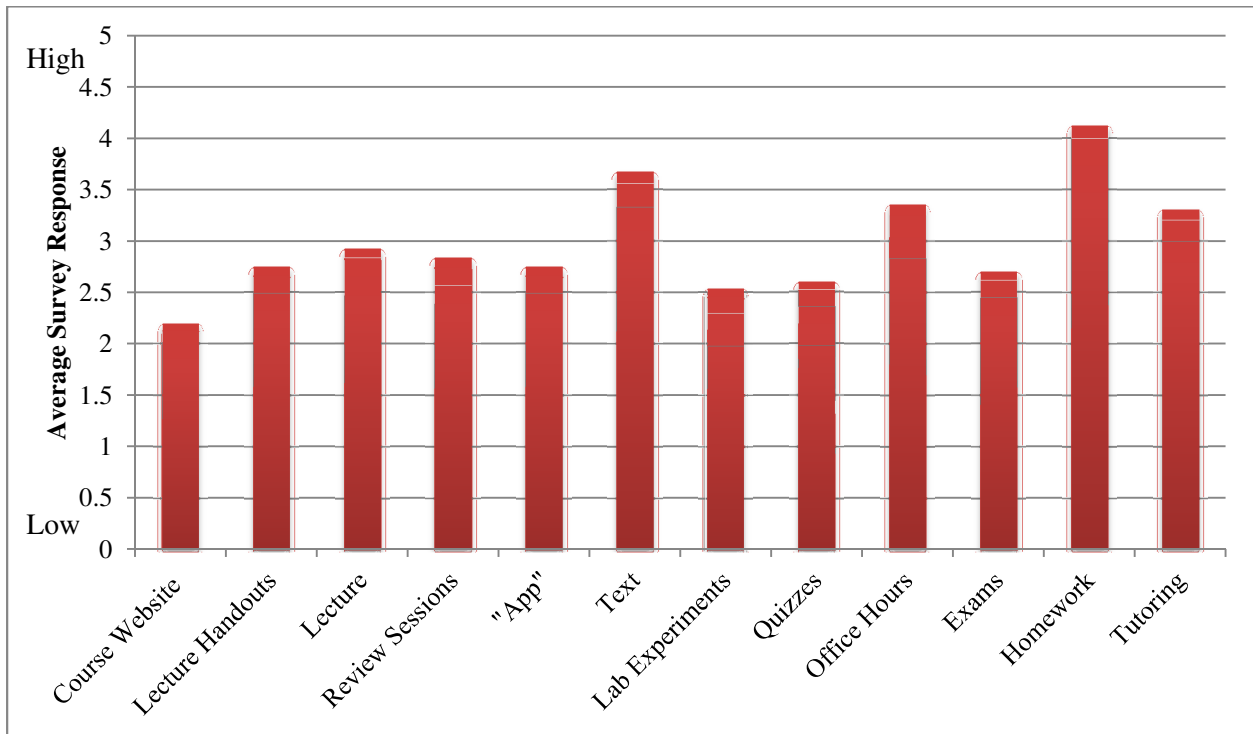


Figure 3. Students **rated** the effectiveness of twelve course components in helping them learn.

Since the App was introduced into the course to accomplish specific objectives or learning outcomes, the end-of-semester survey asked students to rate six specific aspects of the assignment. Working with a partner was rated the highest, and the quality overall was above average. Figure 4 shows that students rated the App as a quality learning experience.

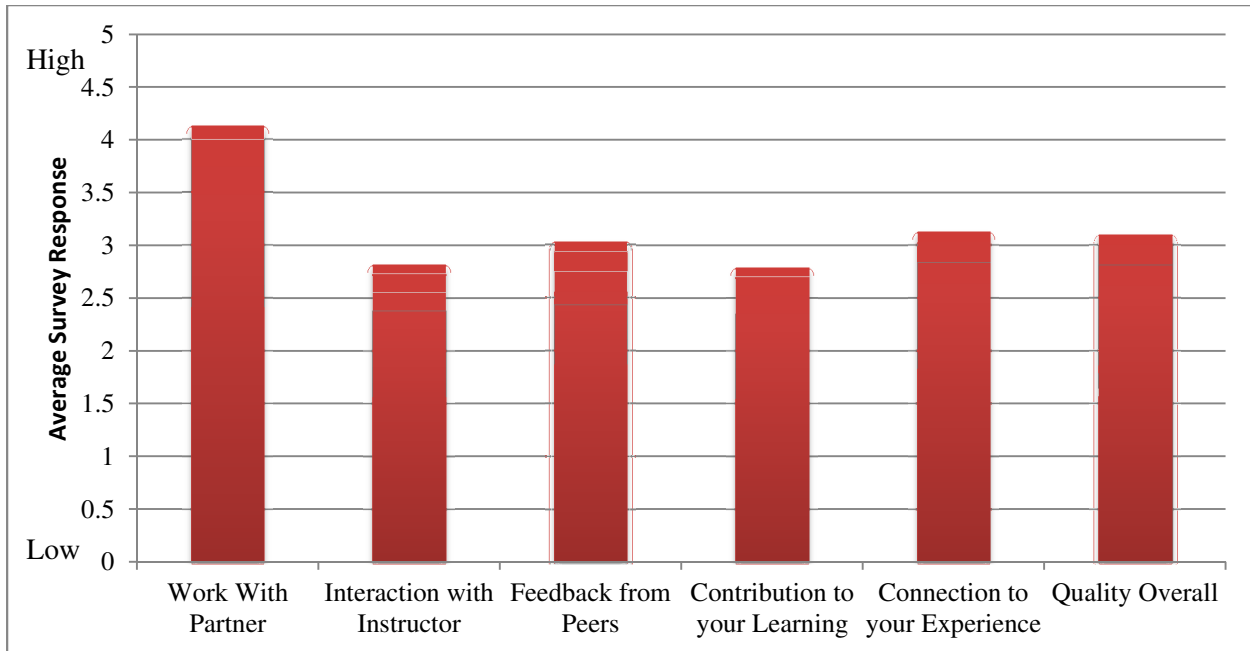


Figure 4. Students rated the App as a quality experience in helping them learn.

The reflection essays indicated a general positive feeling of students towards the App project, and clearly suggested that students saw it as a useful component of the Fluid Mechanics course. Students identified that their opinions of the App were somewhat positive towards the project itself and its encouragement of their learning. While many students did not address the learning benefit of the App in their reflections, a few groups mentioned it as a positive experience in the class. One group wrote that the App was a good method of relating the presented material to real-world experiences and expanding on the material. Another pair of students commented that investigating the scientific principles of an everyday device was enlightening and fun. No group wrote negatively about the experience. Many wrote that the presentation had highlighted their weaknesses in public speaking, and that they were motivated by the assignment to work on that skill; one group concluded that it saw the App as preparation for a career in engineering. A look at specific student reflections will further demonstrate the usefulness to the App assignment.

- “Doing this presentation on an application to fluid mechanics was a great learning experience. We presented on wind mills and how they relate to fluid mechanics. It was a great topic and we think that the class really appreciated the presentation.
 Many things worked well for our presentation. For instance, the timeline used in the slides worked really well to help visualize the history of wind mills. We also had quite a few pictures which made presenting very easy for we mainly just had to talk about the pictures. Our topic was also fairly simple. Keeping a simple topic allowed us to go into a little more detail and explain things that some of the students may have never thought about regarding wind mills. Our application was also very accurate and relevant.

In addition to the things that went well, there were also a few things that we could improve upon. One of the biggest comments was that we read too much off of the slides. This took away a lot of our eye contact which is something that is important in order to be a good speaker. It was also mentioned that some of our slides had a lot of words. Due these comments we decided to eliminate some of the words [from] our slides and instead just speak on these points. We also could have had a better explanation of how the turbine generates electricity. Much of the class still seemed confused on that point.

Overall, this we learned a lot from this presentation and project. We have made changes to our slides and have posted them online. If given the opportunity to give our presentation again, we are confident that we would fix our problems and do excellent work. For future presenters, the biggest recommendation that we have is to come to class well prepared and practice your presentation ahead of time. This will give everyone presenting much more confidence and as a result you will seem more credible as you present.” Student Group 1 reflection essay is from the topic: windmills.

- “A couple of our peers commented on the delivery of the presentation. Some believed that the presentation went by too quickly, others felt we were moving around a bit too much, and that we could have been louder. This problem could have been addressed by more practice between the two of us. We only ran through our presentation in front of a computer. It would have been beneficial to run through our presentation using a projector and in a classroom so we could gage the volume level. In general, more practice and experience giving presentations would have helped with the delivery of the presentation.

Along with the negatives came some positives. Students found our presentation funny, which we intended it to be. We wanted to add humor so that everyone wouldn't be bored, and felt humor would liven up the overall presentation. Secondly, our topic of lift seemed to go over well with everyone. One or two people felt we over-simplified or didn't go enough in depth, but the majority of the students like that we related it to a relevant topic (Badger football). We believe using a topic everyone could relate to helped us get the concept of lift across better.

It was very helpful to review the comments made by our peers. We would not have known about all these issues that others picked up on, and it will make us better presenters in the future.” Student Group 2 reflection essay excerpt is from the topic: lift.

- “We were happy with the way that the presentation went and it increased our interest in fluid mechanics. We liked that we could find a concept that was easily applied to a common situation. We're definitely excited to see other application presentations both in lab and lecture, and the ones that we have seen have been very helpful.” Student Group 3 reflection essay excerpt is from the topic: confined flow.
- “For future presentations we will remember to limit the amount of text on slides, continue to use visuals to explain difficult concepts, and talk with enthusiasm to keep the audience's attention. Other than those minor things, we thought that doing the applications was an interesting way to relate fluid mechanics to real world applications and expand the knowledge that the course provided. We also enjoyed watching other presentations, and learned a lot of things that we had never really thought about before.” Student Group 4 reflection essay excerpt is from the topic: superfluids.

The required department survey assessment at the end of semester, compared to the previous year/s, showed substantial increases in instructor and TA evaluations and improvement in learning subject matter and course structure. The end-of semester survey identified several issues that need attention for the future, but demonstrated that the App assignment is effective in helping students learn. The teaching team and department will continue to address the issues that need improvement.

Conclusions

1. Student reflections are an important component of an assignment or class to help students learn; reflection is a meta-cognitive skill that improves learning.
2. Learning outcomes explicitly shared with students help students learn and help instructors align all course components, i.e. lectures, homework, labs, assignments, quizzes, tests; articulating and writing the learning outcomes on slides and course components make them visible.
3. Hearing explanations of challenging concepts from peers helps students learn; the presentation component of the App was particularly helpful.
4. The App and new approach contributed to student interest and understanding in fluid behavior and mechanics.
5. Intra-course assessments showed that the new approach (a) significantly increased learning of concepts and principles, ability to apply these principles, clarification of text and lecture by homework, and connections among lecture, homework, quizzes, and labs; (b) the App strongly helped learning concepts, principles, phenomena, and applications; and (c) examples lead to better learning in lecture and laboratory/discussion.
6. One semester evaluation of learning improvement with the App and new approach is insufficient to evaluate the short and the long term benefits on student learning.

Recommendations

Based upon this experience, recommendations are:

1. Continue connecting student experiences, observations, and curiosities with course concepts.
2. Continue adapting the App assignment for improved student learning.
3. Make learning outcomes/objectives explicit throughout and align them with all components of the course.
4. Integrate student reflections into the course for effective learning.
5. Monitor performance in follow-up water engineering design courses.
6. Determine ability to apply fluid flow concepts, principles, and methods to problem solving 3 – 5 years after graduation in practice.

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Appendix 1: Example Assignment – Incorporating Authentic Engineering Experiences into Undergraduate Education

Civil & Environmental Engineering App (Applied Learning Activity): Real-world Application of Fluid Mechanics Concept (5% of grade)

One week during the semester, you and your partner/s will have the opportunity to demonstrate your understanding of a fluid Mechanics concept. This assignment has four parts:

- 1) Identify example and relate it to a fluid mechanics concept
- 2) Design and deliver presentation
- 3) Review feedback and revise slides
- 4) Write and post reflection with slides

Each week, the teaching assistants will select one of the three presentations from the three labs for the large lecture. The teaching assistants will use the peer assessments as well as their own assessments to select the most accurate and professional presentation. Their decision will be final. You may want to make revisions to your presentation if yours is chosen for the large lecture.

Learning Objectives: As a result of this assignment, you will be able to

- 1) Demonstrate your understanding of a specific fluid mechanics concept
- 2) Apply a specific fluid mechanics concept to a real-world situation
- 3) Communicate your application in a clear, concise manner to your peers
- 4) Design visuals to accurately demonstrate.

Here's how the application will work:

Phase One: Identify example of real-world fluid mechanics. Think about your work experiences, observations around campus, and current events described in newspapers and journals. You may choose a concept that has been demonstrated before. However, you will get an extra point for demonstrating a new concept, that is, one that has not been the focus of a presentation in your lab.

Phase Two: Design and deliver a five-minute presentation to include these parts

- 1) Identify context (what happened, when, where, why)
- 2) Describe fluid mechanics concept/principle
- 3) Explain application of principle to situation
- 4) Recommend solutions or alternatives, if applicable

Phase Three: Review feedback and revise slides for completeness and accuracy based on your presentation and feedback. Add one slide that lists the important changes in content. The title of that slide could be, "Slide Revisions"

Phase Four: Write and post reflection with slides. With your partner/s, write a reflection after reviewing assessments from peers and video. Include what worked well and suggestions you have for future presentations. Post the reflection.

Assessment Forms

CEE310 App Assessment for All Students to Complete Presenters:

Fluid Mechanics Concept:

Criteria	Excellent work overall 5	Solid work generally 3	Passable work but with cause for concern 1	Comments
Content (50%)				
Delivery (25%)				
Visuals (25%)				
Extra Point for New Concept: Yes (1) No (0)				Grand TOTAL

Comments

Overall Assessment:

What did you like most?

What needs the most improvement?

Check all the attributes that the presenters demonstrated:

[] accurate, [] innovative, [] creative, [] professional, [] other: _____

Name of student evaluator: _____ Date: _____

CEE310 App Grading Rubric for TA

Presenters:

Fluid Mechanics Concept:

Criteria/Names	Comments	Points
Content (50%) Hook Context (what happened, when, where, why) Fluid mechanics concept - Application of principle to situation Recommendations, if any		50
Delivery (25%) Volume, eye contact, poise, timing, persuasive, clear, concise, correct, complete, credible, creative, coherent		20
Visuals (25%) Clear, supportive		20
Discussion Forum Post Slides, reflections		10

Name of Teaching Assistant: _____ Date: _____