

Applying Active Learning Principles in Engineering

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Many studies have shown that active learning improves classroom effectiveness. Students learn concepts more easily and have better retention of those concepts when they are actively engaged in the education process. Instructors become more effective when they learn to apply new approaches to presenting "old" concepts in a manner that allows the students to really get involved. The instructor is responsible for taking the initiative to develop a curriculum where such active learning opportunities exist.

This project has developed several ideas that have been applied at Minnesota State University, Mankato, in teaching several engineering courses. Two courses, including a sophomore-level ME 212 Statics class and a junior-level CIVE 360 Geotechnical Engineering class, have been the focus of this capstone project. Unique opportunities are present in each course, and a variety of active learning tools have been applied in each class.

At MSU Mankato, as at other institutions, Statics is a required course for students in the civil and mechanical engineering programs. At MSU, Statics is also a required course for electrical engineering majors, although many universities offer the class as an elective for electrical engineering students rather than as a required course. Thus, students enrolled in Statics at MSU Mankato range from sophomores in the mechanical and civil engineering programs to juniors and/or seniors in electrical engineering. Many students have a basic understanding of what a truss is, having seen roof or bridge trusses at some point in time. However, introducing such truss analysis concepts as the method of joints or the method of sections can be less tangible from the students' perspective.

Many of these students became interested in engineering by taking things apart (toys, clocks, etc.) while they were young, determining what "made it tick", then putting it back together in such a way that (hopefully) it worked as well as it had earlier. Active learning at a young age stimulated discovery and understanding. This capstone project incorporated several

tools that have allowed engineering students to better understand what makes trusses "tick", using a "hands-on" approach that lets them be active in their education.

The photographs in Figure 1 show one of the tools applied in the Statics classroom – a simple bridge truss made from a K'nex set. Students are able to physically see how an analysis such as the method of joints really works, and why! Rather than observing text and figures from a book or on the chalkboard, students can literally take the truss apart, gain an understanding of how it works, and better appreciate the mechanics involved.

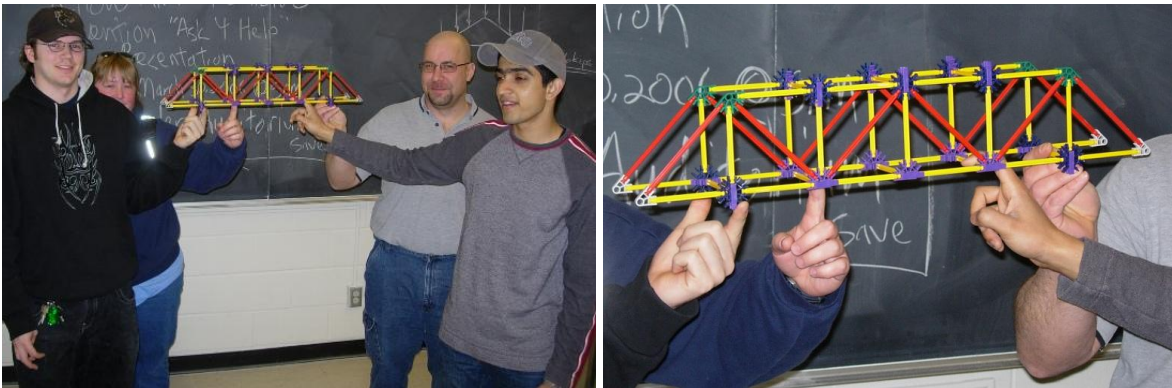


Figure 1. K'nex truss for teaching Engineering Statics

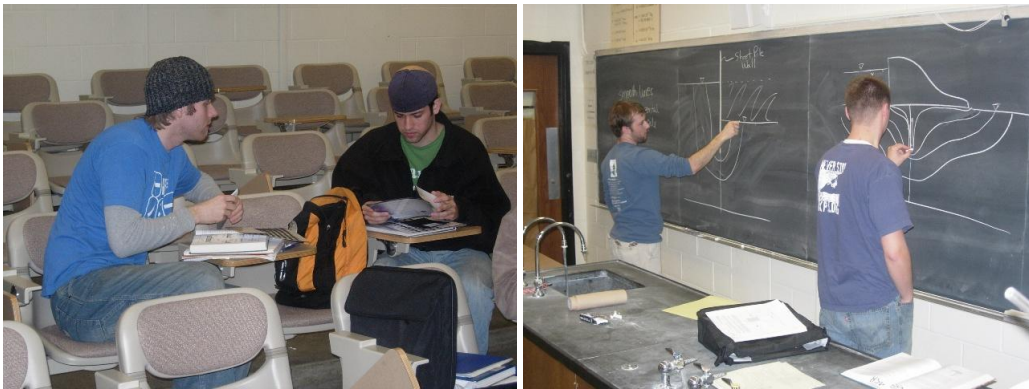
Several methods of applying active learning have also been used in the CIVE 360 Geotechnical Engineering class. One useful tool is fondly referred to as the "Liquefaction Tank." Funding for this project was obtained by Dr. Jim Wilde through MSU, and I was fortunate to have the chance to share in developing the tank and having the lion's share of the opportunities to use it.

With this tool (shown in Figure 2), such concepts as Soil Phase Relations, Seepage Properties, and Soil Liquefaction can be examined and visualized. Students are involved in measuring tank dimensions, flow rates, pressure heads, etc. as such concepts are presented. The liquefaction phenomenon is seen in action before the students' very eyes! A scale model of the Ostrander Bell Tower catches the eye, and the students are able to try various things in an attempt to create the quicksand condition of minimal soil strength.



Figure 2. Liquefaction Tank for teaching Geotechnical Engineering concepts

Additionally, such active learning techniques as Think-Pair-Share groups, boardwork by the individual students, and student presentations were all incorporated in the CIVE 360 course (see Figure 3). Such application of active learning has been helpful in increasing the comprehension of the students, as well as amplifying their enthusiasm for learning. Through this process I have challenged myself to develop additional active learning applications in these and other courses, such that my overall teaching effectiveness can improve and the education that the students achieve can expand.



(a)

(b)

Figure 3. Think-Pair-Share (a) and Boardwork (b) by the students in Geotechnical Engineering