Learning Styles and Integration of Management and Engineering Students

Arup Maji
Professor and Chair, Civil Engineering, University of New Mexico,
Albuquerque, NM 87131amaji@unm.edu

Mahmoud Reda Taha
Assistant Professor and Regents' Lecturer, Civil Engineering, University of New Mexico,
Albuquerque, NM 87131 mrtaha@unm.edu

Abstract

The Department of Civil Engineering at the University of New Mexico is the only department in the United States to offer accredited BS degrees in Civil Engineering, Construction Engineering and Construction Management. In an attempt to better integrate the Engineering students and Management degree students as well as to seek new efficiency in teaching, the Construction Management students were required to take a 4 credit course that was previously required only of the Engineering students. The course on "*Civil Engineering Materials*" includes a significant laboratory component and was to become the only laboratory course taken by the Construction Management students in their 4-year curriculum. Starting Fall 2006, the prerequisites and course content were changed to accommodate the new clientele. The integration proved to be challenging partly due to the diverse academic background of the two cohorts of students (management and engineering). As the class progressed through the semester actions were taken to minimize the influence of these factors on student success. However, in spite of the corrective actions the final grades of the two groups showed distinct divergence. This prompted the authors to explore Kolb's Learning Style Theory to investigate possible psychological variances among the two groups. The results of this study shows that the Engineering students tend to have a penchant for 'Abstract Conceptualization' over 'Concreteness', while Management students had a preference for 'Active Experimentation' over 'Reflection'. Relevant data supporting this finding along with a statistical interpretation are provided here.

Introduction

The current description of the 4-credit undergraduate course being discussed, CE305 Civil Engineering Materials is as follows: "*Lecture and laboratory studies of the physical, structural, mechanical and chemical Properties of civil engineering materials including cementitious and bituminous materials, metals, wood and composites. Experimental determination of materials properties*" Approximately 40 students were enrolled, 15 of whom were pursuing a degree in Construction Management (accredited by ACCE) and the remaining 25 pursuing BS degree in Engineering (accredited by ABET-EAC). The motivation to include the 15 Construction Management students into this course was both to foster interaction with the Engineering students as well as to

provide a laboratory experience otherwise missing in their curricula. Rogers and Ohrn (2007) pointed out the need for current faculty members to improve productivity and teaching effectiveness in light of the growth in the enrolments in Construction Management programs. The ACCE accreditation requires at least 25 hours of Construction Science which can be comprised of introductory-level engineering courses.

The class consisted of an equivalent of 3-credit hours of lecture and a 1-credit laboratory. The evaluation of students comprised of regular homework assignments, laboratory reports, laboratory participation evaluated through an oral examination, a mid-term examination and a final examination. The scores (grades) obtained by the two groups of students (Engineering vs. Construction Management) are shown in Figure 1. There was clearly a difference between the two groups in all measured criteria with the total score of the Engineering students being more than one standard deviation higher than that of the Construction Management students. Moreover, it is evident in Figure 2 that the variation among the Construction Management students was greater in all of the evaluation criteria compared with Civil Engineering students (coefficient of variation is the standard deviation divided by the mean).

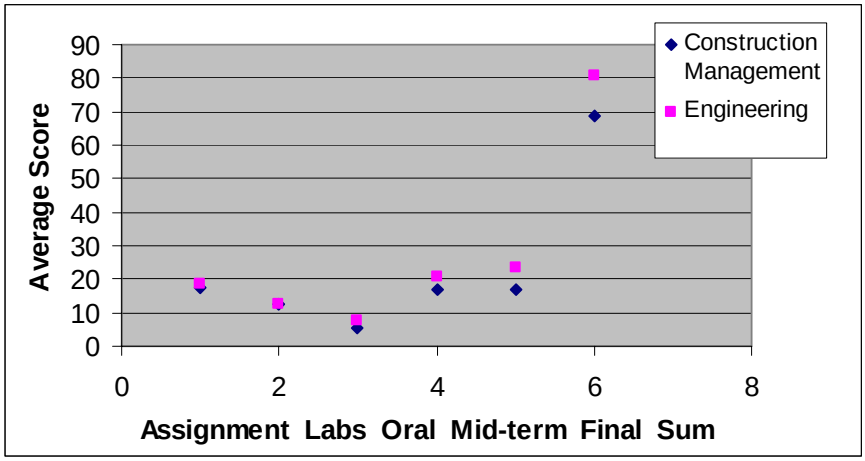

Figure 1. Average score of the two groups in different categories

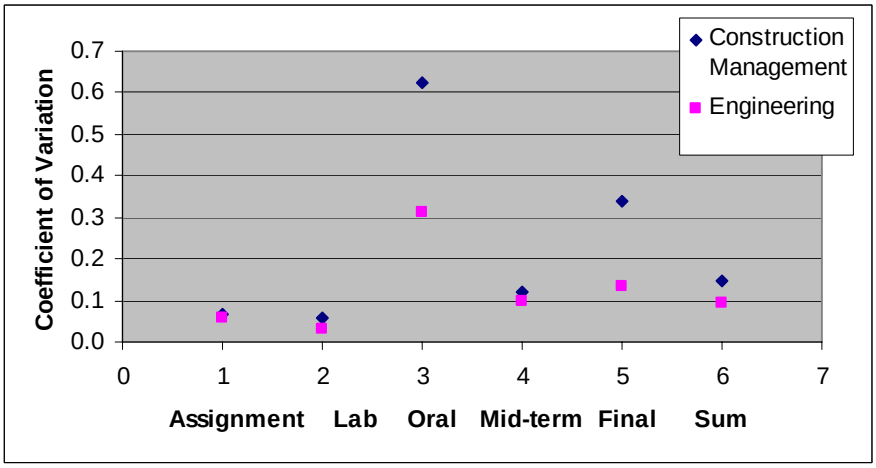

Figure 2. Coefficient of variation in average scores among the two groups

Teamwork for Effective Learning of Diverse Groups

To integrate both groups, teamwork through hands-on experiments in the laboratory and co-operative learning styles in the lecture room were implemented. The laboratory teamwork was performed by dividing each group in the laboratory into teams of four to five students including both Civil Engineering and Construction Management students. Students were informed that teams cannot be changed in experience of real life work groups in the industry. Care was given to ensure that for each team including Construction Management students, at least two students of each discipline exist in the team. While this forced diversity it also avoided putting students in positions where they can feel isolated for being significantly different than the rest of the team. Similar considerations were taken to ensure appropriate support for women students and students from underrepresented groups. Each team was supposed to carry out the laboratory experiment together in the lab, analyze the data together and compile a laboratory report to be delivered in one week. Comprehensive lab reports were requested asking teams to critically visit ideas together, comprehend the experiments, make their own discussion and comments on the results and integrate all of that in a good technical report. It became obvious to the authors that such teamwork enabled good blending of the two different categories of the students and enabled all students to contribute to the learning process with their different backgrounds.

Moreover, the authors examined the process of co-operative learning in the lecture room. Students were divided to groups of four to five students in the lecture room (according to their random sitting). Examples examined by the authors were given to the groups to discuss between themselves for a few minutes before the instructor interference and try to come with problem solving strategy to discuss with the instructor. This process introduced 10-15 minutes of informal interruption to the formal lecture atmosphere and gave students a chance to discuss, participate and blend in work groups. This process also offered students from the Construction Management group the chance to observe and learn engineering strategies for problem solving by being exposed to the thinking steps. Finally, student's participation in classroom co-operative sessions provided good basis for student evaluation. It was obvious to the instructor that student participation and learning grew with time.

Learning Style Analysis

The Kolb's Learning Styles Inventory (1976) assigns a set of words describing personal preferences (experimentation, conceptualization, observation, etc.) and attitudes (intense, reserved, active, pragmatic, etc.). An individual's preferences for one word over another are used to determine how they receive, process and retain knowledge. The assessment performed had 9 rows of words, each row with 4 columns. The students were asked to look at one row at a time and select which of the 4 words in the row best or least characterized/described their learning style. The students assign a number 1-4 to each word depending on their preference. Unknown to the students, the words in each of the 4 columns represent 4 different type pf preferences (Concrete Experience CE, Reflective Observation RO, Abstract Conceptualization AC, and Active Experimentation AE). Once

the scores on each of these 4 categories is tallied, the score for AC-CE is a measure of a student's preference for Abstractness over Concreteness. Similarly, the score for AE-RO is a measure of a student's preference for active experimentation over reflection.

The results of this study are shown in Figures 3 and 4. Figure 3 shows that Engineering students have a strong preference for Abstractness over Concreteness; which is not true for Construction Management students (Figure 4). Figure 5 shows the AE-RO score of Construction Management students, demonstrating a strong preference for Active Experimentation over Reflection. Although Engineering students also indicated a preference for Active Experimentation over Reflection, it is a far less distinct preference (Figure 6) compared with the Construction Management students (Figure 5).

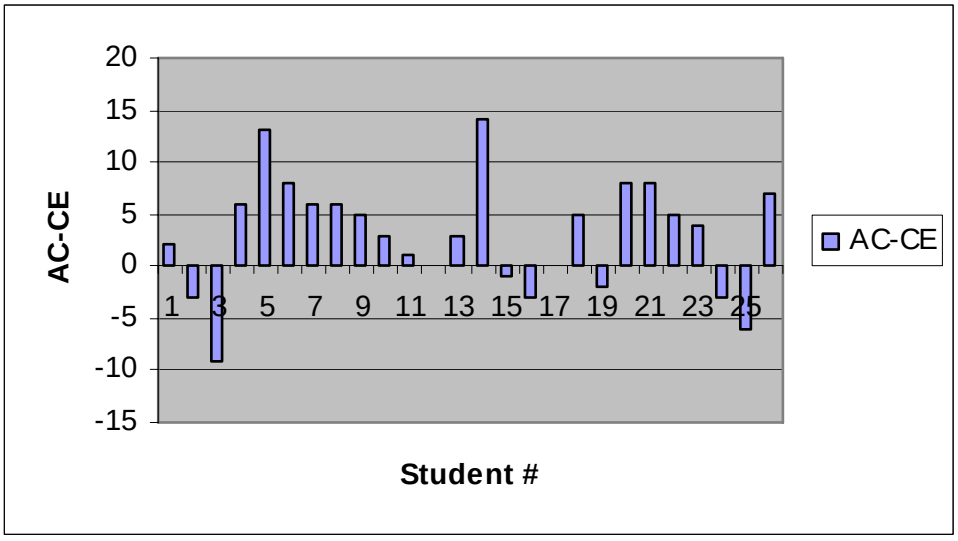

Figure 3. AC-CE score of Engineering students

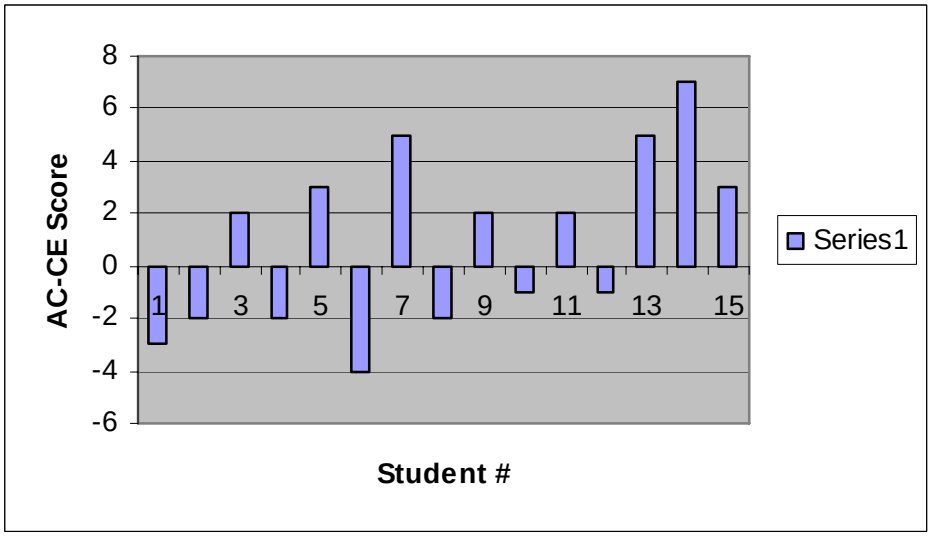

Figure 4. AC-CE score of Construction students

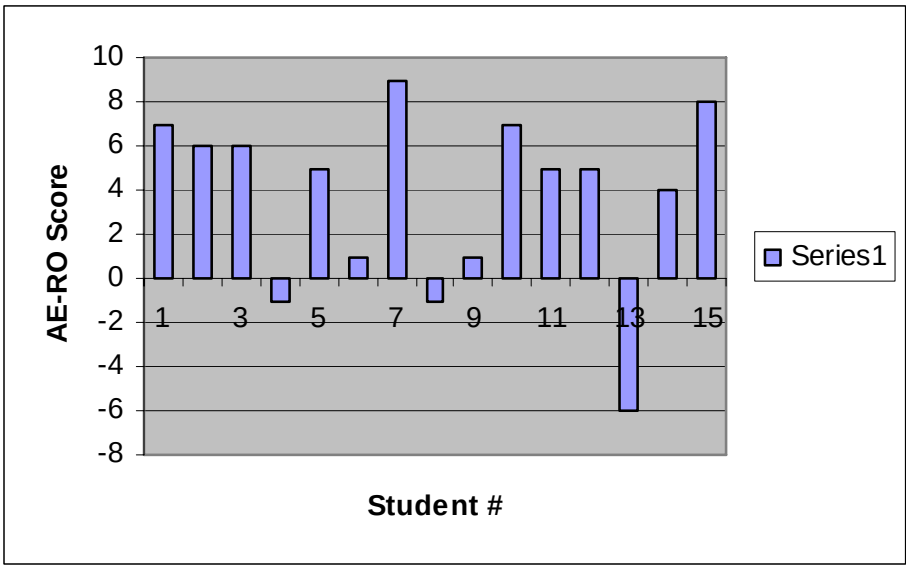

Figure 5. AE-RO score of Construction students

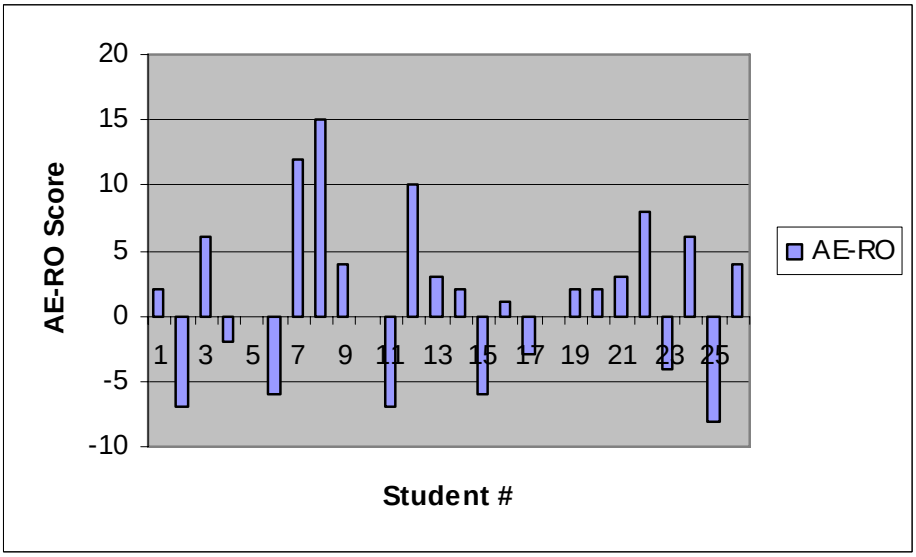

Figure 6. AE-RO score of Engineering students

Rogers and Ohrn (2007) stated that Construction Management students tend to be visually-oriented and critical thinkers rather than analytical thinkers. This personality difference could play a significant role in career choice and performance of Construction Management students in Engineering Science classes. Choice of career depends on numerous factors, some of which were discussed by Koch (2007). According this study, Construction Management students often cite their desire for 'hands-on' activities as the

reason for choosing their career path; performance and community oriented activities could be more enticing to them than analytical classes. It was very evident to the instructor that the Construction Management students enjoyed the laboratory experiments and work the most over other analytical duties. Better learning with such diverse groups requires establishing good links between the experimental observations and the analytical parts of the curriculum. It is obvious that students appreciating the value of laboratory observations better understand the analytical framework when seeing an implementation value. Another factor relevant to our students is that a significant portion of their prior higher education experience was at the local community college. The increasing role of community colleges was discussed by Selingo (2007), who points out that almost one fifth of Engineering students begin their career at community colleges. The author points out that most university professors believe that being with the same cohort of students at the university and facing similar requirements is better than transferring from a community college. Incidentally, New Mexico's Department of Higher Education has began creating a more homogeneous process of articulation and transfer of courses among 2 and 4-year higher education institutions.

Conclusions

Variation in students learning has many attributes among which are prior preparation, nature of the course etc. Special efforts were performed to blend the two diverse groups of students through teamwork in the laboratory and the lecture room. The reader is to be cautious in recognizing the significance of such parameters which were outside of the scope of this paper.

Analysis based on Kolb's Learning Styles theory shows that the Engineering students tend have a penchant for 'Abstract Conceptualization' over 'Concreteness', while Management students had a preference for 'Active Experimentation' over 'Reflection'. It is possible that this difference in personality traits play a role in how individuals select their profession/major. This difference in personality trait coupled with the varying past experience (community college experience) led to greater variability in the learning experience of the Construction Management students.

References

Koch D. C., "Experiences and relationships that influence construction management students' career choice", International Proceedings of the 43rd Annual Conference of the Associated Schools of Construction, Flagstaff, AZ, April, 2007, pp. 353-363.

Kolb D. A., "Learning Styles Inventory", McBer and Company, Copyright, 1976.

Rogers T. and Ohrn G., "A hybrid curriculum for improving faculty productivity and learner-centered effectiveness", International Proceedings of the 43rd Annual Conference of the Associated Schools of Construction, Flagstaff, AZ, April, 2007, pp. 231-242.

Selingo J., "Role Reversal", ASEE Prism, March 2007, pp. 26-31.