# The Effect of Student Placement on the Assessment of Learning and Teaching Styles

**Dr. Moses Kwame Tefe, Norwich University**

Moses is currently an Assistant Professor of Transportation Engineering at Norwich University, where he instructs students in Transportation Engineering, Surveying and Site Development. He graduated from the University of Alabama in August 2012 with a PhD in Civil/Transportation Engineering, and started working with Norwich University, immediately after graduation.

He had his college education in Ghana, where he graduated with a BS in Civil Engineering. After that he worked as a Traffic/Transportation Engineer for ten years with a private consulting firm in Ghana called Associated Consultants, before proceeding to the Netherlands in 2002 to pursue a Master's degree in Urban Infrastructure Engineering and Management. After completion in 2004, he returned to Associated Consultants until 2007 when he gained admission to The University of Alabama. His work experience include traffic studies, signal design, pre-contract services like writing of technical proposals and post-contract services like project supervision

**Prof. Edwin R. Schmeckpeper, Norwich University**

Edwin Schmeckpeper, P.E., Ph.D., is the chair of the Department of Civil and Environmental Engineering at Norwich University. Norwich University was the first private school in the United States to offer engineering courses. In addition, Norwich University was the model used by Senator Justin Morrill for the Land-Grant colleges created by the 1862 Morrill Land Grant Act. Prior to joining the faculty at Norwich University, Dr. Schmeckpeper taught at the University of Idaho, the Land-Grant College for the State of Idaho, and worked as an engineer in design offices and at construction sites.

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**Moses Tefe**[a]

## Introduction:

The learning styles of many students and the teaching styles of many professors are incompatible in several ways. For example some engineering students learn by seeing and hearing, reflecting and acting, memorizing and visualization; while some professors lecture, and others demonstrate or discuss. Mismatches do exist between common learning styles and traditional teaching styles and this can affect student performance[1]. The traditional and dominant approach to teaching is where students typically receive information from the instructor in the form of lectures, without any active participation in the process by the student[2, 3]. There is increasing awareness among the academic community that this style of teaching often times does not meet the learning styles of many students, so students tend to pick and select what to process and ignore the rest. The resulting effect is that some of the material is not learned. However, research shows that a teaching style, which embraces a variety of techniques to meet the learning styles of most students, is the one that makes the most impact on student outcomes[1].

This realization has led researchers to explore more hands-on variations to the traditional teaching style. In some of these research studies, student performance is compared across different classroom environments or under different learning conditions, where different sections of the same class are offered to groups of students in different settings to test a given technique. Results are then compared to observe the effect of the different interventions on student outcomes. Some of the research studies have been in the form of comparisons between the traditional lecture type of teaching and some forms of hands-on learning, where students in one condition receive the traditional passive instruction from an instructor, and the second group of students is engaged in some form of active learning[4]. Some of the comparisons are also between different forms of hands-on learning styles, and common comparisons include inductive versus deductive learning [5, 6], inquiry-based instruction versus direct learning[7], discovery learning versus traditional methods[8] and collaborative learning versus learning from lecture[9].

Selection of students for these kinds of research is often done through normal student registrations. The different course sections are made available to students, and based on their own preferences and constraints, students are allowed to select the classes that best suit their schedules. But what happens if students in one class tend to be remarkably more intelligent than those in a second class. And if this happen how does it affect the results of the research, since student performance is compared based on a common matrix such as student grades at the end of the study period? These are the questions that this study is about to investigate.

## Literature Review

Engineering education has been in the spotlight for many years, leading to calls for reform, and these calls have come from numerous panels, commissions and agencies like the American Accreditation Board for Engineering[10]. So it is not a coincidence that engineering educators are taking many steps to develop more effective instructional methods that facilitate better learning among engineering students. The development of new teaching methods however, is not a novelty as there is countless research literature in general education, technical education, and educational psychology, detailing teaching methods that have been shown to facilitate more effective learning than the traditional single-discipline lecturing approach[10, 2].

The traditional instructor-centered method of education is considered passive learning, because the student passively receives information from the instructor in the form of a lecture, and the student learns by listening and observing passively, and/or taking notes as the lecture progresses[4]. Under these conditions, internalization of the material is often realized through memorization. Although this passive transfer of knowledge has been the dominant method of teaching, many educators argue that students need more than mere transfer of knowledge and the search for a more effective approach to education has led researchers to explore other teaching techniques that are less focused on the instructor[2,11].

Over the past 40 years, many teaching techniques have been developed, which tend to improve on the traditional passive method[2]. Most of the new methods are active learning techniques that have some element of student engagement beyond the passive approach. Active learning is an umbrella innovative student-centered instructional technique that actively involves students in the learning process[4]. Active learning can be achieved through activities that allow students to do something with the information that they are receiving, such as pausing in lectures for students to consolidate their notes, interspersing short writing exercises in class, facilitating small-group discussions within the larger class, incorporating survey instruments, quizzes, and student self-assessment exercises into the course[11,12,13].

Active learning has been studied in many disciplines and in most instances it has been implemented in the context of problem-based, discovery, collaborative, cooperative, team-based and inductive learning methods or some other form[14,15,16,17]. Although researchers have postulated the superiority of active learning over passive learning[16,17], there are counter arguments which suggest that active learning techniques do not always produce better outcomes than passive learning[18,19,20,21]. Nevertheless others argue that even if active learning does not appear to have improved overall mastery of a subject, there is evidence to suggest that it can lead to improved cognitive outcomes in class-specific materials. The difficulty in accepting active leaning over passive learning also stem from the fact that most of the active learning research are qualitative research, focusing on attitudinal reactions like student satisfaction, rather than

cognitive outcomes[2]. Adding to the complexity of the active/passive debate is the mode in which some of the comparisons are being carried out.

Sinead, Namara & Dannenhoffer (2013)[22] examined hands on teaching tools that were deployed in a smaller statics class of 40 students at Syracuse University, and compared the results with a larger class of 63 students who were instructed in the traditional way of lecturing. The course pair was taught for three different years and in two of those years students in both classes were made to take the same final exams and the results were compared. Students from the smaller class were found to have an average of 84% and the average grade from the large class was 77%. Although this result was not considered to be decisive, it was concluded that there were some positive lessons from the hands-on activities in the smaller classroom that were worthy of emulation and for application in the larger traditional class. Two forms of assessment were used for these classes. The first form of assessment was done by a team of independent research evaluators, who observed both classes over a period of time and gave comments on the differences found. The second assessment tool was pre- and post- survey on students' perceptions about the courses. There was no mention about the placement of students so it is believed that students registered into the course sections at will.

Michele, Cater, & Varela, (2009)[2] studied the role of delivery styles on learning outcomes by comparing two teaching styles across two sections of an introductory business course taught by two different instructors in the same semester. One of the classes was taught using active teaching techniques by incorporating a number of active learning exercises, while the other was taught using the more traditional passive approach that emphasizes daily lectures. Two assessment instruments were used to determine student outcomes from the classes. One was a 7-point Likert scale survey, which was administered in both classes to assess participants' perceptions of the teaching methods. The results from both classes were contrasted using a t-test. The students also took a common final exam and the exam scores were used to measure class-specific and broader knowledge acquired from both classes. In their study they found that active learning does not improve the overall mastery of the subject, but can lead to improved learning of some class specific materials.
Student placement in both classes was not controlled in any way as the students freely registered into the class of their choice, but without any prior knowledge of the teaching methods that were going to be used in either class. Nevertheless, students in the larger traditional class were found to have slightly lower high school GPAs and ACT scores.

Miglietti and Strange, (1998)[23] examined students' preference for different teaching styles, their expectations of classroom environments, and how these two factors contribute to students' academic achievement and satisfaction. The study involved 106 students from 5 remedial English courses and 5 remedial math courses in a community college. The students were qualified for the remedial courses based on their scores from a placement test, but those scores

were not used in placing the students in any of the ten classes. Questionnaire interviews and student scores were the assessment tools used in this study also.

Menekse, Stump, Krause & Chi (2013)[4] evaluated the effectiveness and applicability of an active learning framework, to find out how differential activities affected undergraduate engineering students' learning outcomes. Study 1 was conducted in an engineering classroom during normal class sections, while study two was carried out on a different set of students in a laboratory environment. Students' cognitive learning outcomes were measured under both conditions. The study was not designed to make comparisons between results from the two settings, but to understand the effectiveness of the framework on student learning outcomes.

In most cases however, results from two different settings are compared to draw conclusions on the effectiveness of teaching techniques. Each class has a set of students with different capabilities, which will definitely affect the outcome of the experiments. Felder & Silverman (1988)[1] argued that different students have different learning styles and that how much a student learns from a class is partly governed by the compatibility of the student's learning style, and the instructor's teaching style, but also by the student's native ability and prior preparation. This means when students register unselectively into two different classes that are going to be used to observe the impact of a teaching technique and the method of assessment is to compare the grades of students from the two settings, it is obvious that the results will not only reflect the impact of the teaching technique, but will also be a reflection of the students inherent capabilities. So if students in one of the classes are generally less endowed than students in the second class, the results of the experimentation will be skewed and not be a true reflection of the teaching technique being tested.

## Methodology

In this study, the investigator is teaching a sophomore engineering survey class, which has two sections that are taught on the same day and in the same classroom only 10 minutes apart. The earlier class has a bigger size of 25 students compared to the second class of 14 students. These initially appeared to be an ideal configuration to practice an active teaching style to test the effect of class size on student outcomes. So having attended an active learning workshop just before the semester, the instructor decided to practice the skills acquired from the workshop, by incorporating some active learning techniques in the teaching process, such as pausing some of the time for 5 minutes or less and allowing students to have small brainstorming. The instructor does not keep lecturing throughout the period, but also paused from time to time, allowing students to individually think about the information being received. When a problem is to be solved in class, students are often given the opportunity to try solving the same problem in small groups first, before the instructor solves it on the board. Visuals were also used to enhance the lectures. All these efforts were made to appeal to the different learning styles in the classrooms, and the same active teaching techniques were used in both classes.

## Results and Discussions

There were some interesting aspects of this study. The instructor is a new Professor, in the third semester of teaching and so still learning to become an effective instructor. This is the first time this particular course was being taught by the instructor, and also the first time of using these active learning techniques. So from the instructor point of view, there was much learning to be done in perfecting the teaching delivery process. It was believed that there was increased mastery over the teaching process in the second class, as the first lesson served more as a teaching practice, which could be of benefit to the second class. Also since the second class was smaller, that encouraged more efficient interaction with the students than in the larger first class. With this dual advantage, the class performance in the second and smaller class was expected to be better than the first and larger class, all things being equal.

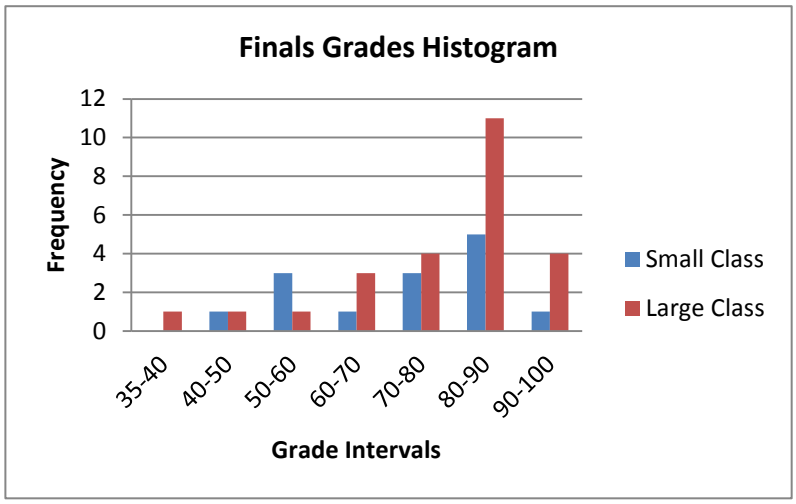


**Figure 1: Grade Frequency Distribution**

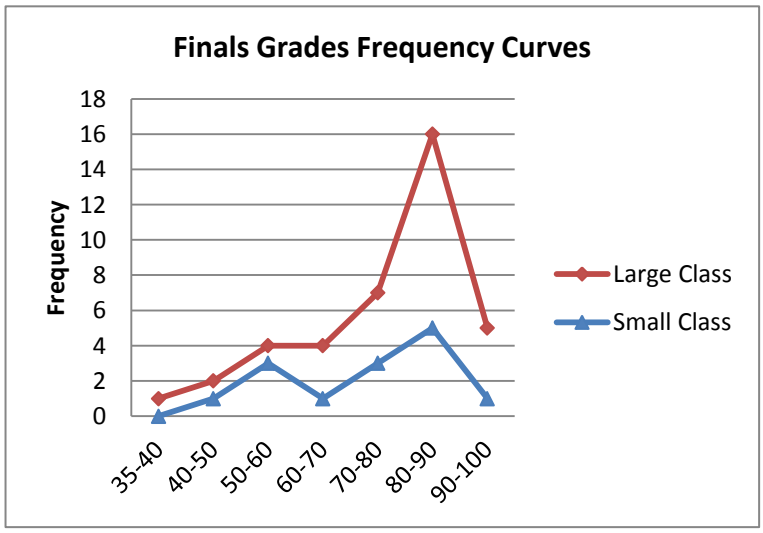


**Figure 2: Finals Grade Frequency Curves**

However, the grades from the finals at the end of the semester did not support this expectation. As seen in Figures 1 and 2, the finals grades from both classes were quite comparable in the lower ranges, with the lower class grades being worse in the lower ranges of 60% and below. In the higher margins of 70% and beyond, the larger class out-performed the smaller class. The average grade from the finals for the larger class was 82.4% and that from the smaller class was 78.3%. The grade difference of 4.1% may not be significant, but considering the fact that the average performance from the more privileged class was lower than the performance from the less advantaged class raised an important question that needs to be investigated: Could the results have been different if the student composition in the classes were more balanced intellectually? Looking at the ACT scores and High School GPAs, it was clear that there were more intelligent students in the larger class than in the smaller class, so the performance in the smaller class was more reflection of the inherent capabilities of the students than the instructor advantage that they had over the larger class. So if these classes were an experimentation to examine a teaching technique from the two classrooms, based on exam grades as is often done, the results could have led to an erroneous conclusion.

## Conclusion

The lesson learned from this study was that comparing the averages from two classes without linking it with the past performance of the students could be misleading. And that for class comparisons to be realistic, student placement into different sections should have some element of control. This can help produce a comparable cohort with balanced native capabilities in the two classes. This is a work in progress. The next step will be to examine possible ways of registering students into classrooms for the sake of research so as to have classes with balanced strengths, without unduly inconveniencing students. It is also recommended that there should be research into finding ways of factoring student native abilities into the results of research findings that use class comparisons.

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