Using Learning Styles as a Group Selection Technique

Chris H. Bachmann

This paper was completed and submitted in partial fulfillment of the Master Teacher Program, a two year faculty professional development program conducted by the Center for Teaching Excellence, United States Military Academy, West Point, New York, 2010.

ABSTRACT: Undergraduate and graduate programs often dedicate part of a course’s graded requirements to group projects. In SE481, a discrete event simulation course taught at the United States Military Academy, 50% of the course grade comes from group projects. Due to the large amount of the course dedicated to group work, it is important to consider how students are grouped for these projects. A common technique used to group students is allowing them to self-select their group members. Students usually prefer this method, and it is easy to argue that this would lead to better performance because of better group dynamics. However, a brief review of the research on this topic refutes this argument. The research on this topic favors grouping students based on their learning style. As a new instructor at the United States Military Academy, the author of this paper had to participate in a four week Faculty Development Workshop. Over the course of this workshop, it was stated that students not only prefer self-selected groups but also performed better in these groups. In order to confirm which of these two grouping methods is superior, the author conducted an experiment over two academic terms with five sections of SE481 students. The results of this research support using learning styles as a grouping technique.

Introduction

The motivation for this research originated in the summer of 2008, during my Faculty Development Workshop (FDW) in the Department of Systems Engineering (DSE). FDW for DSE is a four week process that integrates incoming faculty into the United States Military Academy’s (USMA) academic environment and educational philosophy. The process begins with understanding the mission of USMA which is “To educate, train, and inspire, the Corps of Cadets so that each graduate is a commissioned leader of character committed to the values of Duty, Honor, Country and prepared for a career of professional excellence and service to the Nation as an officer in the United States Army.” (USMA n.d.) Each department then takes the Academy’s mission and incorporates it into their departmental educational philosophy.

FDW’s intent is to integrate newly arrived instructors, but its primary goal is to make new instructors better teachers. Throughout the four weeks, there are numerous classes on successful teaching practices. During the discussion in these classes the topic of student project groups was addressed. The lead instructor for FDW stated that grouping students for projects was left to the discretion of the instructor. Additionally, he said his experiences showed students preferred self-selection over other group selection techniques. He also explained that he felt that students preformed better in self-selected groups. I felt this was a reasonable assumption. From a personal perspective, I preferred self-selection and believed this should normally result in better performance. However, a review of the research in this area did not support his or my assumptions.
The Master Teacher Program (MTP) was also introduced during FDW. The program was presented as a course that focused on teaching excellence. During the first few meetings of the MTP, the MTP instructor stated that each participant would have to complete a literature review or research paper. I felt this was a perfect opportunity to investigate the following research question:

*Is there a statistical difference in group performance between self-selected groups and those groups composed of mixed learning styles?*

The above question will be the focus of this paper. Included in this paper is a detailed explanation of the experiment and analysis used to answer the question above. Before providing this analysis, it is important to provide a description of the different learning styles and a brief review of the related areas of research associated with them.

**Learning Styles**

Every individual conforms to one of four basic learning styles: visual, auditory, kinesthetic, or tactile. Describing these in a simple manner, a visual learner gravitates toward reading and studying charts, auditory toward listening to lectures or audiotapes, kinesthetic toward physical involvement, and tactile toward hands-on, such as building models (Reid 1987). The last two styles of kinesthetic and tactile are very similar. As a result, they are often combined. I combined tactile with kinesthetic in order to reduce the basic learning styles to three. This decision was made because the majority of the groups studied in this research were composed of three students. Additionally, people receive information in three ways: sight, sound, and touch. By reducing the basic learning styles, it better aligned them with the way people gather information.

Recognized learning styles go far beyond the four basic ones discussed above. Other categories used to describe an individual’s learning method are: sensing, intuitive, inductive, deductive, active, reflective, sequential, and global. These can combine to describe 32 different learning styles (R. M. Felder 1988). For example, a student could be a visual, sensing, inductive, active, sequential learner. However, one can see this could quickly become untenable when attempting to conduct classroom research.

Previously, it was stated that most college students are visual learners. (Reid 1987) further discovered that preferred learning styles were found between undergraduate and graduate students, males and females, and across language backgrounds. For example, graduate students and males significantly preferred visual and tactile learning while Japanese speakers were the least auditory of all learners (Reid 1987).

As this section illustrated, there are many ways to label a learner. Additionally, it demonstrated there are many different ways to analyze the characteristics of a specific type of learner whether by education level, sex, or native language. While doing in-depth analysis beyond the basic learning styles was outside the scope of this paper, this section provided an appreciation of the potential complexity found in researching learning styles.
This completes the discussion on learning styles, a review of the related research is provided in the next section.

**Review of the Applicable Literature**

The research related to learning styles typically focuses on three areas: learning in the classroom, cooperative learning and group contingencies, and group selection criterion. Learning in the classroom is the most common learning style research conducted. This research studies the affect of teaching style verses learning style and its affect on student performance. Most college students are visual learners; however, most college instruction is delivered verbally (R. M. Felder 1988). This mismatch in styles between teaching and learning negatively impacts students. In classes where teaching and learning styles are seriously mismatched, students are uncomfortable, bored, inattentive, perform poorly on tests, and in extreme cases change courses or drop out of school completely (R. M. Felder 2005). (Charkins 1985) further iterates this with the study of economic students. (Charkins 1985) makes the following two conclusions:

1. “The larger the divergence between teaching style and learning style, the lower the student’s gain in achievement in economics.”
2. “The greater the divergence between teaching style and learning style, the less positive the student’s attitude toward economics.”

As the studies above indicate this should be a major area of concern for instructors. As a result, the MTP dedicates one session to this topic. It addresses the fact that classrooms are comprised of learners with different learning styles. In order for an instructor to touch each of the different styles, the instructor must use multiple techniques when presenting material. This should result in higher quality instruction and better meet the goals of the USMA academic program.

The second area concerned with learning styles is cooperative learning and group contingencies. Cooperative learning is any method used to have students work together in order to assist each other in learning (Slavin 1991). This topic is often studied with group contingencies. Group contingencies are techniques that reward groups for the learning of the individual members (Slavin 1991). However, these studies often ignore the affect group selection techniques have on their performance. For example, (Gokhale 1995) arbitrarily chooses self-selection over random assignment and criterion-based methods without explaining why.

The final area of considerable research on learning styles is as a group selection criterion. As indicted in the introduction, current research does not support that groups perform better with self-selection. The studies show that groups are more effective when they have mixed learning styles (Kayes 2005). The literature also indicates that using mixed learning styles to group students proves better than non-mixed learning style groups. (Wolfe 1977) compared learning styles in both homogeneous and heterogeneous groups. This study quantifies the potential performance increases gained from groups comprised of mixed learning styles. It shows that the heterogeneous groups significantly
outperformed their homogeneous groups by a factor of two (Wolfe 1977). Finally, the research by (Halstead 2002) is of great interest because it is based on engineering students which is the same as the students in this research. It found that engineering students grouped by learning styles out performed self-selected groups.

This section was intended to provide a quick description of the related research associated with learning styles. The following section will discuss the assessment techniques used in this research along with how I employed them in the classroom.

Assessment

In order to answer the research question, I collected and measured the performance of the different grouping methods. This was accomplished through classroom assessment. Classroom assessment is a teaching approach that provides feedback on the teaching-learning process for both the instructor and students (Lowman 1995). There were numerous assessment techniques available, so it was important to choose those that were most helpful in gathering the data required for the type of analysis being executed. After reviewing the 50 assessment techniques described in (Angelo 1993), I selected 10 that I felt would best collect the data needed to answer the research question posed in the introduction. These techniques are:

1. Directed Paraphrasing. Directed Paraphrasing assesses the student’s ability to apply “declarative knowledge to a new context” (Angelo 1993). For this research, students had to give a presentation on their final project. This provided feedback to the instructor of whether they understood their problem and the concepts learned in the classroom. This approach was a little different then presented by (Angelo 1993) but gathers the same information.

2. Project Prospectus. Project Prospectus is simply an outline for a term paper or project (Angelo 1993). The groups in this experiment had to provide a project proposal which was a brief description of the system they would model. They also had to describe the role each group member would serve in completing the final project.

3. Classroom Opinion Polls. This technique allows students to provide anonymous feedback on course-related issues (Angelo 1993). I surveyed students prior to grouping them on their opinion toward grouping methods. Additionally, students were given a survey to complete after both project three and the final project to provide feedback on themselves and their partner’s level of work and participation.

4. Self-Assessment of Ways of Learning. Each semester, one section of students was required to complete a Visual, Auditory, and Kinesthetic (VAK) Learning Style survey. I used this to determine which of the three learning styles each student most aligned and then grouped that section of students according to these learning styles.

5. Diagnostic Learning Logs. Diagnostic Learning Logs are condensed versions of the commonly used academic journal (Angelo 1993). After completion of the final
project, I surveyed the students to determine their opinion on their method of grouping. Additionally, the survey asked whether the student felt their grouping method helped, hurt, or had no affect on their learning.

6. **Teacher-Designed Feedback Forms.** This is similar to Classroom Opinion Polls, but this assessment technique is more standardized (Angelo 1993). Gathering this information was possible through questions included on both the peer assessment survey and the end of course survey students are required to complete.

7. **Group Instructional Feedback Technique.** This is similar to technique five but asks only three questions of the students: What works, What doesn’t, and What can be done better (Angelo 1993). I asked these questions in the group assessment survey. The survey asked these questions in the context of how their section was grouped.

8. **Grade Comparison.** Grade Comparison was very important to answering the research question because grades provide the most straightforward method for determining statistical significance. The researcher compared grades within academic terms and across academic terms. The sample sizes used in this analysis were small but sufficient to provide results and make conclusions.

9. **Group-Work Evaluations.** This is a simple method for students to provide their opinion on working in groups (Angelo 1993). Again, this assessment technique was included in the peer assessment survey provided after each group project. The survey questions asked what their partners helped with the most and what they helped with the least. Also, students had to answer these same questions about themselves.

10. **Assignment Assessments.** Assignment Assessments provide students the opportunity to give feedback on the value of work completed throughout the course (Angelo 1993). USMA like most universities has a standardized online end of course survey that students are required to complete. I used these surveys to assess the students’ opinions on the four projects completed during this course.

I integrated these 10 assessment techniques into the classroom the first semester I gathered data. However, I discovered that some techniques were more useful in collecting the data needed to determine whether there was a statistical difference in group performance based on grouping method. For example, I could easily assess and measure Grade Comparison and Directed Paraphrasing assessment techniques. However, Project Prospectus was not easily measured because the groups only had to provide an informal description of the system they would model for their project. Therefore, Project Prospectus was discarded as an assessment technique. In addition, as is evident from the techniques outlined above, there is overlap among them. As a result, I decided to combine seven of the assessment techniques into four separate surveys. The four surveys were a peer assessment survey, a group assessment survey, a learning style survey, and an end of course survey. By taking this approach, it reduced the time students had to spend answering surveys, and it collected the data in a more concise manner. I have now provided a brief background on the purpose for this research, the pertinent literature, and
an understanding of both learning styles and assessment techniques. The remainder of this paper describes in detail the experiment and analysis conducted in order to answer the stated research question.

**Experimental Method**

The course that was used to conduct this experiment was SE481, Systems Simulation. Systems Simulation is a course that focuses on discrete event simulation. There were three sections in academic term 2009-1 and two sections in academic term 2009-2. In academic term 2009-1 there were 45 students and academic term 2009-2 there were 36. During each academic term, I grouped each section by a different technique. I created project groups with the following guidelines:

**Graded Based Grouping.** Students were ranked based on their overall course grade. The student with the highest grade was paired with the student with the lowest grade; the student with the second highest grade was paired with the student with the second lowest grade and so forth. The reason this grouping method was used was because there were more sections first semester than second semester.

**Learning Style Grouping.** I provided one section each semester with a survey in order to determine the students’ learning styles. The survey used to determine their learning style was a VAK survey. The VAK survey is sometimes called a VAKT survey and is based on modalities (Clark n.d.). The VAK survey determines if a student is a visual, auditory, or kinesthetic learner. As stated previously, tactile learning is often combined with kinesthetic learning. This is why the “T” is not included in the VAK survey used. The VAK survey produced a score that indicated the learning style for each student. I then grouped students based off their learning style with each style represented in each group.

**Self-Selection Grouping.** I allowed one section each semester to self-select their groups. The majority of the students chose friends or people that were in their same company.

In SE481, there were four projects. The first two were individual projects and the last two were group projects. The peer and group assessment surveys I created only applied to the group projects. However, the end of course survey accounted for all graded requirements and was more robust. I gave the peer assessment survey after both project three and the final project. The group assessment survey was only given at the completion of the final project. I repeated this process both semesters and did not compile the data until all information was gathered. The next section will describe the analysis used and the insights gleaned.

**Results**

The experiment described in the last section was straightforward and not complicated. However, it required a significant amount of time to gather the data. The goal of this experiment was to determine whether there was a statistical difference in
group performance between self-selected groups and those groups composed of mixed learning styles. Due to the assortment of data collected through the peer, group, and end of course surveys, I was able to make many general observations. Therefore, before presenting the results related to the research question, I will briefly discuss the general observations.

Two questions asked on the peer assessment survey were how much your partner contributed to project completion and what grade would you give your partner for their effort. Those grouped by self-selection felt their partners contributed equally to project completion significantly more than those grouped by grades or learning style. Eighty-four percent of self-selected groups felt their partners contributed equally as opposed to 61.4% for the learning style group, and 37.5% for grade based group. Additionally, self-selected groups were much more likely to give their partner a grade of 100. Individuals could assign any grade that was a multiple of 10 from 0 to 100 to their partner based on their level of effort. After compiling the data, I grouped the grades into one of three categories: 100, 90, and 80 and below. Students rarely assigned grades lower than 80. By doing so, this indicated a very low effort level by their partner. Eighty-one percent of self-selected groups gave their partners a score of 100 while only 62% of learning style and grade based groups gave their partners a 100. However, this does not prove that self-selection is a better method of forming project groups. These results probably indicate a minor amount of bias because 66% of the 81 students in this experiment preferred self-selected groups. There was a significant desire on the part of the student to self-select. If they were unable to self-select, their attitude going into their group was not as positive and therefore, may have resulted in biasing the data above.

The group assessment had a question that asked if their opinion on grouping methods had changed due to the technique used in project three and the final project. Looking across all students regardless of previously preferred learning style, 66% did not change their opinion. Additionally, it asked if their grouping method helped, hurt, or had no affect on their learning. Overall, 51% felt it had no affect. However, 48% of those grouped by self-selection felt it helped as opposed to 38% for no affect and 14% for hurt performance. Again, because self-selection was the overwhelming choice for the students in the experiment, these results were not surprising.

Analyzing the grades for individual work and group work presented the most substantial evidence to answer the research question. During academic term 2009-1, the section grouped by learning style was the only section that had a higher group work average, 93.1%, then their individual work average, 87.7%. Table 1 shows the method of grouping and the averages for each section for their individual and group work.
During academic term 2009-2, both sections averaged higher on their group work than they did on their individual work. While the scores between the sections are very similar, there is a larger difference in the learning style group work average versus their individual work average. Table 2 shows there was a 2.4% difference in the learning style groups’ work versus their individual work. Whereas there was only a 1.6% difference in the self-selected groups’ work versus their individual work.

The last result of interest before discussing the results from statistical testing is that of combining learning style groups from both academic terms and comparing it to the combined self-selected groups. Both learning style and self-selected groups performed better on their group work than their individual work. As before, the learning style sections scored higher than the self-selected sections on their group work. As Table 3 illustrates, they averaged 3.6% higher on group work than the self-selected groups but only 0.7% higher on individual work.

While the analysis above was interesting, it does not definitively answer whether there was a statistical difference between self-selection and mixed learning style groups. The information above only provided anecdotal evidence that mixed learning style groups perform better. In order to statistically prove whether the differences discussed above are significant, hypothesis tests had to be performed. I conducted five hypothesis tests using the Welch Confidence Interval method. I chose the Welch test because only pair-wise comparisons were performed and one of the test did not have an equal number of data points; therefore, a paired-t test could not be used. All five tests used the same hypothesis test convention illustrated in Figure 1.
In Figure 1, H₀, the null hypothesis, stated the compared grades are the same; there is no significant difference. H₁, the alternative hypothesis, stated the grades being compared were different and there was a statistical difference. Using this convention in each test, I tested the null hypothesis that the grades being compared were the same or not statistically different.

Only two of the hypothesis tests resulted in statistical significance. The learning style section from academic term 2009-1 proved significant between its group and individual work. There was also statistical significance for combined learning style sections from both academic terms between their group and individual work. Conversely, there proved to be no statistical difference between the learning style sections and the self-selected sections. However, the Welch Confidence Interval (-0.0724, 0.0003), for this test is very close to excluding zero. If it were to exclude zero, you could state there was a statistical difference. Since this interval was close to excluding zero, I decided to conduct an Analysis of Variance (ANOVA) in order to better confirm or deny statistical significance. The results of the ANOVA were equally close to the defining line of accepting or rejecting the null hypothesis that the grades for the grouping methods were the same. The $F_{critical}$ value equaled 3.9934 and the $F_{calculated}$ equaled 3.9992. $F_{calculated}$ marginally exceeds $F_{critical}$. Therefore, the null hypothesis should be rejected and indicated there was a marginally significant difference in the two grouping methods. Additionally, the $p$-value for the ANOVA test was 0.04984. Similarly, this showed that there was a marginally significant difference in the two grouping methods. Now with all of the results presented, the final section will discuss the conclusions gained from this analysis.

Conclusions

The purpose of this research was to determine whether there was a statistical difference in group performance between self-selected groups and those groups composed of mixed learning styles. The information did provide anecdotal evidence that implied that learning style groups did perform better. However, the results did not definitively answer the research question. The Welch Confidence Interval test failed to reject that the grades for the learning style group and the self-selected groups were different. Conversely, the ANOVA test did reject the hypothesis that their grades were the same indicating statistical significance with 95% confidence. The ANOVA showing statistical significance meant the learning style grouping method did outperform the self-selected grouping method. The two tests contradicted each other, but they did support that the results were marginal in both cases. Since the data available fell near the discriminating line for these two statistical tests, future work could be conducted on collecting more data.
and adding it to this analysis. More data would most likely result in a definitive answer from these statistical tests.

While the research question requires further research in order to provide a definitive answer, the data did show there was a statistical difference within the learning styles groups. In both academic terms, the learning style sections performed better on group assignments than individual assignments. Additionally, the Welch test showed these results were statistically significant. This was true both for individual academic terms and combined terms.

At the start of any research, the intent is to answer a research question. However, if the data does not result in a clear answer, it does not devalue the work as long as knowledge is gained from the process. This research provided interesting support for the case that there is value in grouping students based off their learning styles. I did not believe this to be the case prior to this research, but this work has changed my opinion. It was shown that students in the learning style groups were the only sections to perform better on group work than individual work during both academic terms. The group assessment surveys showed that students prefer self-selection more, but even with this desire, the learning style group grades were higher in every scenario. Also, in every scenario, the learning style sections had a larger delta between their individual grades and group grades. Considering all the information, I believe using learning styles to group students has positive benefits, and much of the analysis performed in this work favorably supports it.
Works Cited


