A Study of Learning Styles and Team Performance

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Abstract

This paper reports on a study that was performed over a 4-year long period in which the performance of undergraduate mechanical engineering students on a team project, enrolled in a senior mechanical systems course at the University of Rhode Island, was correlated with their learning styles as measured by the Brain Dominance Model. To measure the learning style of each student, the Brain Works program, developed by Synergistic Learning Incorporated, was used in this study due to its ease of administration and explanation of results. The students were asked to report to the instructor the two numbers that the program generated: one is a left/right brain measure and the other, an auditory/visual measure. In the first two years of this study, the 4-5 members of each team were grouped based on their learning styles score with the objective of forming teams with members whose scores are in three or more different quadrants of the left/visual plane. In the last two years, the teams were formed randomly, but the students were asked to report their learning styles scores. Data was also collected on the performance of each student in the course and in the team project. To determine if the learning styles have any correlation to the performance of the team, a correlation analysis was performed on combination of many variables some of which are exam grade, project grade, and composite learning score for the team. The results show that the competence level of the team as measured by the exam grade has the most influence on the team performance, while the learning style makeup of the team has a less pronounced effect.

Introduction

Methods of forming student teams in project-oriented courses are an area of active research and a topic that generates a lot of discussions among faculty members. Many faculty members at different institutions [1, 2] have reported that team functionality improves if team members were selected based on their learning style. There are many techniques available to classify learning styles such as Kolb's Learning Style Inventory [3-4], and the Myers-Briggs inventory [5]. This paper reports on a study that was performed over a 4-year long period in which the performance of undergraduate mechanical engineering students on a team project, enrolled in a senior mechanical systems course, was correlated with their learning styles as measured by the Brain Dominance Model. To measure the learning style of each student, the Brain Works (Braintest) program [6], developed by Synergistic Learning Incorporated, was used

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in this study due to its ease of administration and explanation of results. Each student was asked to run that program on their own and respond to its 20 questions. The program performs a simple evaluation of the brain hemisphere dominance and also measures whether one reacts in a more auditory or visual manner. The students were asked to report to the instructors the two numbers that the program generated, of which one is a left/right brain measure and the other, an auditory/visual measure.

The study was performed on students enrolled in MCE401 course, a senior-level mechanical systems design course that is offered at the University of Rhode Island. This required course is offered once a year in the fall semester. MCE401 covers topics related to the design and analysis of mechanical system components. The course also covers material related to the mechanical design and assembly of systems using solid-modeling based CAD software. The topics covered in the course are illustrated by asking the students to work on a 10-12 week long open-ended design project in which they are asked to design a device or a machine that needs to satisfy a variety of constraints. The study relates student performance for the four-year period of Fall 2000 through Fall 2003, and it covers the performance of 35 teams formed from a population of 143 students over the four-year period.

Method

In the first two years of this study, the teams were formed by grouping students based on their learning styles. Basically, after a brief explanation of learning styles and methods to assess them, the students were asked to run the Braintest program on their own at the beginning of the semester, and to report to the instructor the two numbers that the program generated. Teams were then formed by combining students from at least three different quadrants, but the students were given the choice of selecting members from these quadrants. Ideally, one would like to form teams that have members from each quadrant, but because the brain classification of engineering students tend not to be equally distributed among the four quadrants, it was difficult to form teams that have members from each of the four quadrants. Furthermore, several students' scores tend not to lie in any one of the quadrants but at the borderline of these quadrants. In the last two years of the study, the instructor randomly formed the teams, but the students were asked to run the Braintest program at the end of the semester and to report these values to him. The team size was 3-5 students. Table 1 gives information about the teams formed in each offering of the course. Note that for the Fall 2002 semester, there were 10 teams (42 students) formed in the course, but the author only included the data for the eight teams (32 students) that had provided complete data about their learning scores.

Figure 1 shows a plot of the brain classifications for the entire 143 students. As seen in this figure, a large number of students tend to cluster in the left brain/visual quadrant with very few students in the right brain/auditory quadrant. Figures 2-5 shows the brain classifications of the different teams in each year. Note that in all these figures, a zero visual score corresponds to an auditory score of 100. Similarly, a zero left score corresponds to a right score of 100. In Figures 2-5, the average project grade obtained by each team is also displayed on the plot data for that team. Due to the use of peer and mentor evaluations in determining the project grade for each student, all the students in a particular team may not get the same project grade. Note that in

the four years of this study, the course was taught by the same instructor with different but comparable exams were given each year.



Fig. 1 A plot of the brain classifications for the entire 143 students

Results and Discussion

To determine if the learning style scores of the team members had any correlation to the performance of the team, a correlation analysis was performed on a combination of several variables. These variables are listed in Table 2, and include average left brain score for the team, average visual score for the team, average project grade for the team, and the average exam grade (midterm and final) for the team.

The correlations results for some combinations of the variables listed in Table 2 are shown in Table 3. The correlation analysis was performed using the "CORREL" function in Excel which takes as an input two series of data. The correlation was performed on the data for each year as well on the data for the entire population. Table 3 also lists the average correlation which is obtained from averaging the correlation results from each year of the 4-year study.

Table 3 shows that there is a consistent correlation between the average exam grade and the average project grade for the team for each year of the study and for the overall data. This confirms the observation that good students perform well in both exams and team projects. Similar consistent correlation was also obtained for the relationship between the team maximum project grade and the team maximum exam grade. Note that these correlations are more significant for Fall 2000 and Fall 2001data where the teams where formed based on their learning style data vs. the data for the last two years where the teams were formed randomly. Since in Fall 2000 and Fall 2001, the students were offered the chance to select their teammates such that the team has members from three or more different quadrants (if possible), many teams ended up with members who are familiar with each other and thus could have worked better together than teams whose composition is completely random.

As for the learning style distribution of the team and its effect on team performance, there was no single measure that gave consistent correlation for each year and the entire sample except for the relationship between the slope of the best fit line through the left and visual points for the team and the team average project grade. This positive correlation means that teams will perform better in general if composed from members whose learning score lie on an axis that runs from the right auditory quadrant to the left visual quadrant.

It was expected that the team performance would improve if the team members were distributed among the four quadrants of the left/visual brain measure. This was true for the data for Fall 00 and Fall 03, but was not the case for the other two years. As for the entire sample, there is a slight positive correlation (0.119) between these two variables. To determine if the "centroid" of the team learning style data has any correlation with the team performance, the correlation between both the team average left score and the team average visual score with the team average project grade was computed (see Table 3). The correlation (-0.736 and -0.447), while in Fall 01 there is a significant positive correlation (0.507 and 0.328). For the entire sample, there is a slight negative correlation (-0.078 and -0.030).

To further assess the data, the ratio of the average project grade to the average exam grade was computed for each year of the study (see Table 1). The results show that teams perform better (relative to their exam performance) if the teams were not randomly formed. While one would like to say that forming teams based on the learning styles results in a better performance, this improved performance could also be to the fact that students were able to select their team members subject to the constraints discussed before.

While it can not be measured in this study, the author has observed that when the teams were formed randomly, the students did not complain about the team makeup because they believe they do not have anything to do with team formation. On the other hand, when teams were formed based on the learning style, students felt that if the team did not perform well, then it is because of the learning style composition of the team.



Fig. 2 Learning style distribution for teams in Fall 2000



Fig. 3 Learning style distribution for teams in Fall 2001



Fig. 4 Learning style distribution for teams in Fall 2002



Fig. 5 Learning style distribution for teams in Fall 2003

Semester	Number	Number	Number of	Team	Average	Average	Avg.
	of	of	Students per	Formation	Exam	Project	Project
	Students	Teams	Team	Method	Grade	Grade	to
							Exam
							Ratio
Fall	36	9	4	BrainTest	64.8	79.7	1.23
2000							
Fall	32	7	4-5	BrainTest	72.5	84.8	1.17
2001							
Fall	32	8	4	Random	73.4	85.0	1.16
2002							
Fall	43	11	3-4	Random	69.3	76.6	1.10
2003							

Table 1. Information about the teams

Table 2. List of variables that were analyzed

Variable	Description	Variable	Description
Number	_	Number	-
Ι	Team Left Average Score	VI	Team Maximum Exam Grade
II	Team Visual Average Score	VII	Slope (left/visual) of the best fit line
			thru the team style data
III	Team Average Project	VIII	Number of quadrants in the team
	Grade		learning style data
IV	Team Average Exam Grade	IX	Average distance of each team member
			data from the team center in the
			left/visual plane
V	Team Maximum Project		
	Grade		

	Correlation Coefficient between Different Variables							
	I,III	II,III	III,IV	V,VI	III,VII	III,VIII	III,IX	
All Data	-0.078	-0.030	0.545	0.429	0.247	0.119	0.127	
F03 Data	-0.561	0.105	0.059	0.292	0.274	0.282	-0.096	
F02 Data	0.444	-0.031	0.268	0.118	0.276	-0.171	-0.107	
F01 Data	0.507	0.328	0.715	0.260	0.215	-0.388	0.299	
F00 Data	-0.736	-0.447	0.591	0.750	0.827	0.439	-0.210	
Avg. of F00–F03	-0.086	-0.011	0.408	0.355	0.398	0.040	-0.029	

Conclusions

From the results of this study, we can draw the following conclusions:

- 1. There is an inconsistent correlation between team learning style distribution and project grade which implies that the learning style distribution as generated by the Brain Works program is not a reliable indicator of the performance of the team. One cannot draw a firm conclusion that having team members distributed in each quadrant of the left/visual plane improves the performance of the team.
- 2. There is slight positive correlation between the average team grade and the slope of the left/visual data set for the team. This positive correlation means that teams will perform better in general if composed from members whose learning score lie on an axis that runs from the right auditory quadrant to the left visual quadrant.
- 3. The study confirms the expected results that good students perform well in both projects and exams.
- 4. The performance on the team project was slightly better when teams were formed based on their learning style vs. randomly formed teams as measured by the ratio of the average class project grade to the average class exam grade. This could be due to the use of learning styles in forming the teams or due to having teams where most of their members know each other. It should be noted that in the two years where teams where formed based on their learning styles, one team from each year has won an award for their design in the annual national design competition run by The James F. Lincoln Arc Welding Foundation which was not the case when teams were formed randomly.
- 5. Other factors could have affected the performance of a team on a project which were not measured in this study. These include the project topic area, and level of difficulty of the project. Because teams select their project topic, some teams end up with very involved project topics that could have affected their grade.
- 6. The repeatability of the learning style scores generated by the Braintest program could have affected the results of this study because several students have reported that they got a slightly different score when they ran the program for a second time.

While the brain dominance classification method that was used in this study may not substantially affect the team performance results, the author believes that exposing students to learning styles concepts helps many students appreciate their preferred method of learning.

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Biographical Information

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