Preferred Learning Activities

Russell Pimmel
Electrical and Computer Engineering
University of Alabama

Abstract

In this study, we utilized end-of-the-semester survey data in which students ranked nine learning activities "in order of their importance in helping a student do well in this course". The activities were: attending lectures, reading the text, reading the objectives, doing homework, doing homework in study groups, attending evening reviews, completing lab assignments, doing in-class exercises, doing in-class exercises in groups. In a second part of the survey, students also indicated the fraction of the lectures they attended, the fraction of the homework they completed, the fraction of the homework they completed in groups, and the fraction of the reading they completed, and how often they read the objectives. These data showed that the students valued and used the lectures and homework and that they devalued and did not use the text and objectives. The study suggested that some students did not respond to the modern instructional methodology tools (e.g., learning objectives, group homework, and active/cooperative learning exercises). It also suggested that these courses contained at least two subpopulations – those that rely on lectures and homework (listening and doing) and those that rely on the text and objectives (reading and thinking).

Introduction

The literature contains many articles describing different learning styles usually characterized by the Learning Type Measure or the Myers-Briggs Type Indicator. (See, for example, Bernhold et al [1] or Sharp et al [2].) In discussing learning types, authors suggest that instructors use an assortment of instructional methodologies or learning activities in order to reach all students [1-4]. Felder and his colleagues have pointed out that using learning objectives and active/cooperative learning are extremely important in reaching the widest mix of students [3, 4]. We have used a wide assortment of learning activities in two digital systems courses and we decided to try to determine what learning activities the students preferred and used and what relationships existed between their preferences and utilizations. We also explored their feeling about the team-based activities in these courses. Finally we wondered if we could distinguish population subgroups, perhaps related to learning types, based on these preferences and utilizations.

Data Collection

This study utilized data collected in two required courses in digital systems, one at the sophomore-level and one at the senior-level. These courses served electrical engineering, computer engineering, and computer science majors. All three majors required the sophomore course; the two computer programs required the senior course while the electrical engineering program used it as a senior elective. In both courses, the instructor provided daily learning

objectives, homework assignments, and active/cooperative in-class exercises. He encouraged students to work in groups on the assigned homework. Both courses had an integrated laboratory and voluntary evening review session before each exam.

In an anonymous end-of-the-semester survey, students ranked nine learning activities (see Table 1) "in order of their importance in helping a student do well in this course". In reporting this data, we used a "ranking score" that ranged from 0 (the least important) to 8 (the most important).

Attending lectures	Doing homework	Completing lab assignments
Reading the text	Doing homework in group	Doing in-class exercises
Reading the objectives	Attending evening reviews	Doing group in-class exercises

Table 1. Learning activities

Using five pre-selected ranges (0 –10 %, 10 – 25 %, 25 – 50 %, 50 – 90 %, and 90 – 100 %) in a second part of the survey, students also indicated the fraction of the lectures they attended, the fraction of the homework they completed, the fraction of the homework they completed in groups, and the fraction of the reading they completed. They also indicated how often they read the objectives, again using five pre-selected frequencies (never, once or twice during the semester, before each exam, weekly, and nearly every lecture). To quantify their responses, we used a utilization score that ranged from 1 to 5 with "1" corresponding to the lowest frequency and "5" corresponding tot the highest frequency. We obtained 45 competed forms in the sophomore course and 23 in the senior course.

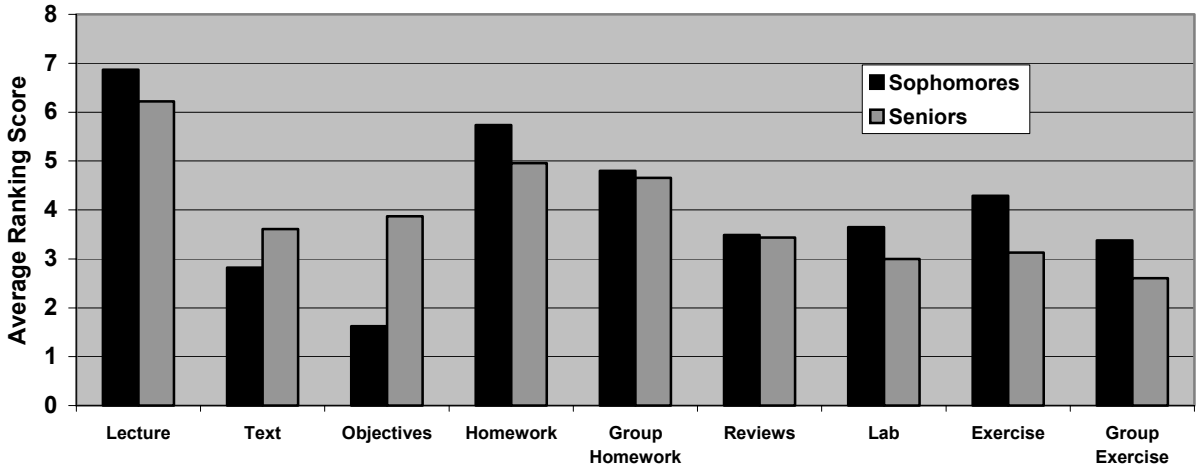

Figure 1. Average Ranking Scores

For each course, we computed average ranking score for the nine activities, and Figure 1 shows these data. In the senior course, the average rankings ranged from 2.6 to 6.2 while in the sophomore course the range was 1.6 to 6.9. In both courses, students placed the greatest value on the lectures, homework and group homework. The sophomores ranked the in-class exercises, labs, and reviews next with the group in-class exercises, text, and objectives at the end. The seniors ranked the text and objectives and review in the middle with in-class exercises, group in-

class exercises, and lab at the end. Thus the seniors placed more value on the objectives and the text than the sophomores did, while the sophomores place more value on the in-class exercises and the labs than the seniors did.

Average Ranking and Utilizations

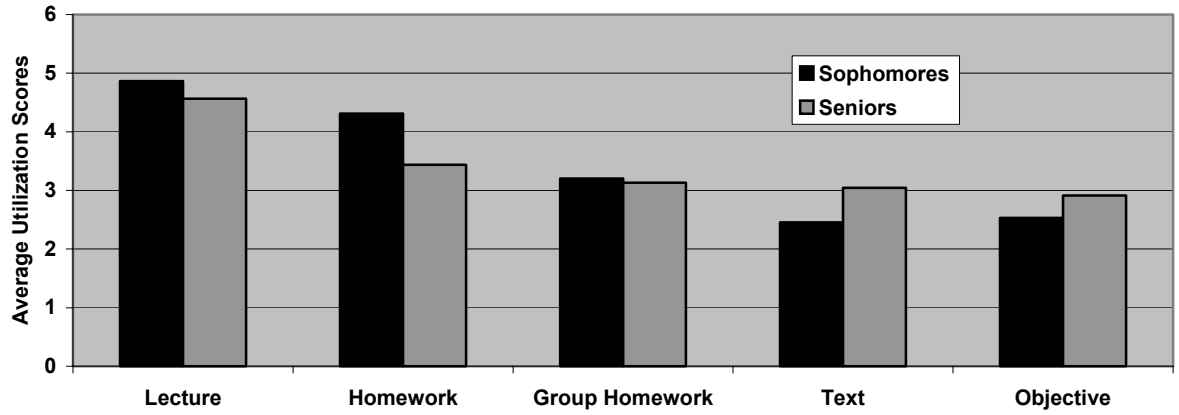

Figure 2. Average Utilization Scores

Figure 2 shows the average utilization scores for both courses. We converted the average utilization scores to percentages using the distribution of the utilization scores and the average value of the five ranges on the survey (e.g., 5 % for the 0-10 % range, 18 % for the 10-25 % range, and 38 %, 70 % and 95 % for the remaining three). We used 0 %, 5 %, 10 %, 35 % and 100 % for the predefined ranges in reading the objectives. Table 2 summarizes the average percent usage of these learning activities for the two courses.

Course	Lectures Attended	Homework Completed	Group Homework Completed	Reading Completed	Objectives Read
Soph.	92 %	77 %	52 %	31 %	7 %
Sen.	84 %	58 %	50 %	44 %	8 %

TABLE 2. Average Usage of Learning Activities

The data in Figure 2 and Table 2 both show that the students attended lectures and completed homework more frequently that they read the text or the learning objectives. Although the differences between the two classes were small, the utilization score data (Figure 2) and the percentage data (Table 2) show that the sophomores attended more lectures and did more homework than the seniors, while the seniors used the text and the objectives more than the sophomores did.

Preference for Group Approaches to Homework and In-Class Exercises

In comparing the ranking scores for homework and group homework, we found that 56 % of the sophomores ranked group homework lower than homework; the average ranking scores were 4.6 and 5.0, respectively. For the seniors, the corresponding percentage was 52 % and the average ranking scores were 4.8, and 5.8. We separated the students in each course into two subgroups

based on whether their ranking score for the homework was greater or less than their ranking score for group homework. In both courses, those that gave a higher ranking to group homework also gave a lower ranking to the text. Thus, students that preferred to do their homework in groups placed less value on the text.

In comparing the in-class exercises to the group in-class exercises in the sophomore course, 67 % gave a lower ranking to the group activity and the average ranking scores were 3.4 and 4.3. In the senior course, the corresponding percentage was 57 % and the average ranking scores were 2.6 and 3.1. We also formed two subgroups using the ranking scores for the in-class exercises and those that gave a higher ranking to the group exercises also gave the lectures a lower ranking. Thus, those that liked doing the in-class exercises in a group placed less value on the lecture itself.

Comparison of Rankings and Utilizations Scores

To analyze the relationship between the ranking and utilization scores, we separated the students in each course into two subgroups based on the fraction of the lectures attended with those attending 90 % or more in one group and those attending less than 90 % in the other. For each preferred learning activity, we computed the difference in the average ranking scores for the two groups. We repeated this process three more times, subdividing the students on the basis of the percent of the homework completed, the percent of the homework completed in a group, and the percent of the reading completed with boundaries of 50 % for the first two and 25 % for the third. Utilization of the objectives by all students was so low that we did not analyze these data in this way.

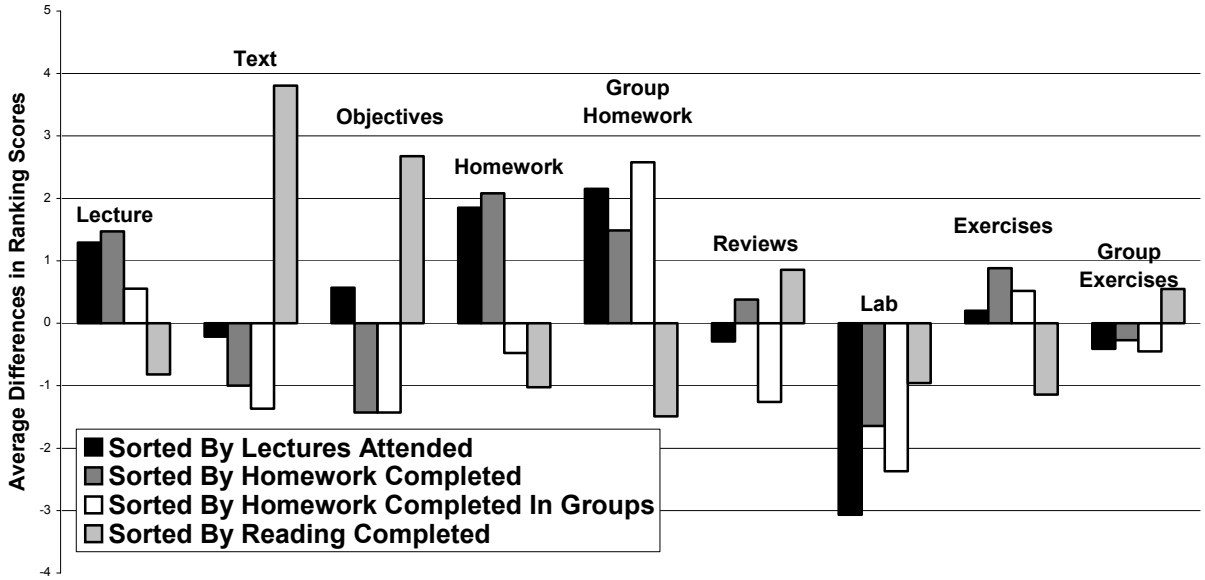

Figure 3. Differences in ranking scores for subgroups formed based on the utilization of the learning activities.

Figure 3 shows a plot of the differences in the ranking scores between the two subgroups formed by separating the populations by their utilization scores for each of the four activities in the

senior-level course. In this graph, the first bar on the right indicates that the subgroup that attended more lectures gave a higher average ranking score for the lectures than the subgroup that attended fewer lectures. As a second example, the fourth bar indicates that the subgroup that completed more of the reading gave the lectures a lower average raking than the one that completed less of the reading.

Table 3 indicates all instances where the absolute value of the differences was greater than one in both courses with a"+" indicating a positive difference and a "-" indicating a negative difference. Figure 3 and Table 3 show that those who attended the lectures valued the lectures, homework, and group homework as indicated by a difference greater than one and devalued the lab as indicated by a negative difference with a magnitude greater than one.

	Activity Used To Form Subgroups							
	Lectures		Homework		Group Homework		Reading	
Ranked Activities	Soph.	Senior	Soph.	Senior	Soph.	Senior	Soph.	Senior
Lectures		+	+	+	+			
Text	-		-	-	-	-	+	+
Objectives				-		-		+
Homework		+		+				-
Group Homework	+	+	+	+	+	+		-
Reviews						-		
Lab		-		-		-		
In-Class Exercises								-
Group In-Class Exercises								

Table 3. Difference in Average Ranking Scores Greater Than Plus One (+) or Less Than Minus One (-).

This table shows that those who attended the lectures valued the lectures and homework (i.e., they assigned high ranking scores) and devalued the text and labs (i.e., they assigned low ranking scores). Those who did the homework valued the lectures and the homework and devalued the text, objectives, and labs. Those who did the homework in groups valued the lectures and group homework and devalued the text, objectives, reviews, and labs. Those who read the text valued the text and the objectives and devalued the homework, group homework, and in-class exercises. Thus it seems that this study contained two populations: one that valued and used the lectures and homework and one that valued and used the text and objectives.

Population Differences

We plotted histograms of the ranking and utilization scores and noted that some of these were bimodal indicating two sub-populations. Figure 4 shows the bimodal histograms of the ranking scores for the text, objectives, and the group homework for the senior course. Figure 5, the histogram of the utilization scores for the group homework for the senior course, has a similar bimodal pattern. Based on these observations, we inferred that our study included two sub-populations that can be distinguished by their preferences and utilizations of the text, homework, and objectives. This inference is consistent with the observation that we made in analyzing the relationship between the ranking and the utilization scores in the previous section.

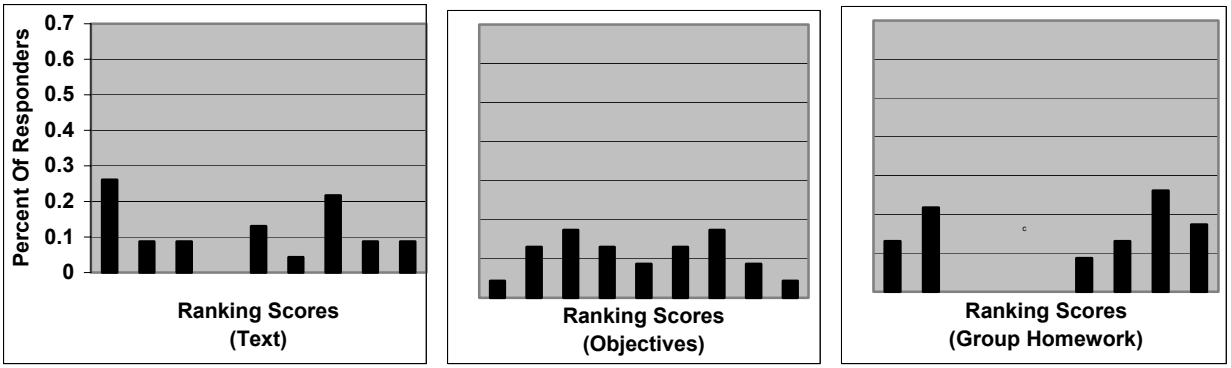

Figure 4. Histograms of the Ranking Scores for Selected Activities.

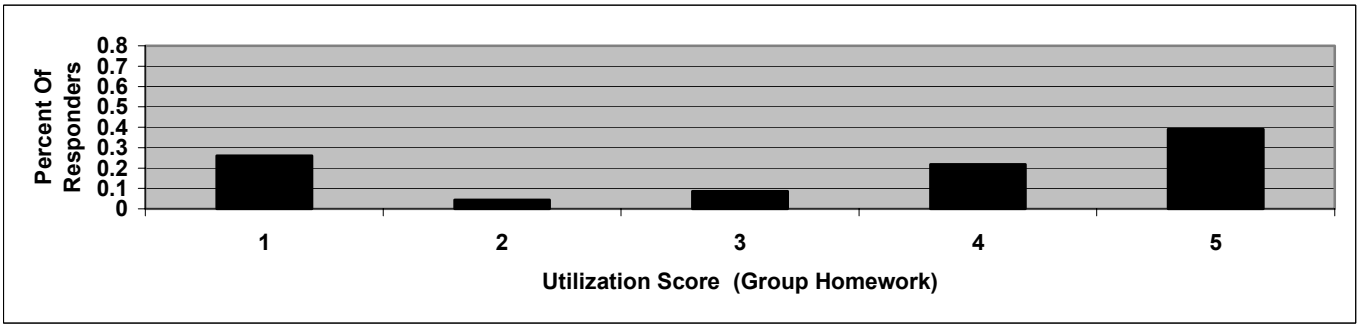

Figure 5. Histograms of the Utilization Scores for Group Homework in the Senior Course.

To further investigate the presence of two populations, we computed the correlation matrix for the ranking scores using Equation 1, where $\sigma^2_{X,Y}$ is the covariance between the two ranking scores while σ_X and σ_Y are the individual variances of the two ranking scores.

$$\rho_{X,Y} = \sigma^2_{X,Y} / \sigma_X * \sigma_Y \quad (1)$$

	Lectures	Text	Objectives	Homework	Group Homework	Review	Lab	In-Class Exercises	Group Exercises
Lectures	1.0								
Text	0.32	1.0							
Objectives	-0.2	0.32	1.0						
Homework	0.1	-0.2	0.08	1.0					
Group Homework	0.26	-0.3	-0.2	0.15	1.0				
Review	-0.2	-0.2	0.23	0.29	0.01	1.0			
Lab	-0.1	-0.1	-0.2	-0.2	-0.3	-0.1	1.0		
In-Class Exercises	0.39	0.17	-0.2	0.02	0.12	-0.1	0.05	1.0	
Group Exercises	0.07	0.04	0.13	-0.3	-0.1	0.27	0.31	0.47	1.0

Table 4. Correlation Matrix of Ranking Scores

Correlation values range from –1 to +1, with +1 and –1 indicating totally dependent variables with positive and negative correlations, respectively, and 0 indicating totally independent

variables. Table 3 shows the correlation matrix computed with the data from the sophomore course. The table does not list values above the diagonal because the matrix is symmetrical. These data show the large positive correlations (> 0.3) between lecture and homework rankings scores and between the text and objectives rankings scores. They also show the large negative correlations (< -0.3) between the text ranking scores and those of the group homework and the exercises. These two observations again support the inference of two populations.

Conclusions

Students, both by the ranking and utilization scores, showed a preference for lectures and homework, the traditional learning activities. They showed less preference for the learning tools based on the new pedagogies involving active and cooperative learning exercises and learning objectives. Thus, even though the literature shows that these newer activities improve learning, students do not readily accept them. Instructors must be patient and persistent in using them and strive to develop their skills with these activities.

Secondly, our data suggest that our courses contain two sub-populations separated by their preferences and utilization of learning activities. One learns from the lectures and homework, that is by listening, taking notes, and doing, while the other learns from the text and objectives, that is by reading and reflecting. Although the correlation is not direct, the distinctions between these two subpopulations loosely corresponds to the two methods of processing information in Kolb's model – the active processors (a combination of Types 1 and 2) and the reflective processors (combination of Types 3 and 4) [1,2]. In any event, instructors should realize that there are a substantial number of students who prefer to learn form the text and the objectives rather than from the lecture and the homework.

ACKNOWLEDGEMENTS

This work was supported in part by the Engineering Education Program of the National Science Foundation under Award Number EEC-9802942.

Bibliography

1. Bernold, L.E., Bingham, W.L., McDonald, P.h. & Attia, T.M. Impact of Holistic and Learning-Oriented Teaching on Academic Success. *Journal of Engineering Education*, vol. 89, pp. 191-199, 2000.
2. Sharp, J.E., Harb, J.N. & Terry, R.E. Combining Kolb Learning Styles and Writing to Learn in Engineering Classes. *Journal of Engineering Education*, vol. 86, pp. 93-101, 1997.
3. Felder, R.M. & Brent, R. How to Improve Teaching Quality. *Quality Management Journal*, vol. 6, pp 9-21, 1999.
4. Felder, R.M., Felder, G.N. & Dietz, E.J. A longitudinal Study of Engineering Students Performance and Retention -- V. Comparisons with Traditionally Taught Students. *Journal of Engineering Education*, vol. 87, pp. 496-4880, 1998.

Biographical Sketch

Russell Pimmel is a Professor in the Department of Electrical and Computer Engineering at the University of Alabama. He earned his undergraduate degree in Electrical Engineering at St. Louis University. His M.S. and Ph.D. degrees are from Iowa State University in the same field. His research concerns neural networks and computer architecture. At the University, he teaches digital system and computer architecture, and capstone design