Can Teamwork be Effective in Learning Software Packages and Improving Report Writing Skills? A Case Study

Dr. M. A. Karim, P.E.
Department of Civil and Construction Engineering
Kennesaw State University, Marietta Campus
1100 South Marietta Parkway, L-114, Marietta, Georgia 30060
Emails: mkarim4@kennesaw.edu/ makarim@juno.com; Phone: (470) 578-5078 / (804) 986-3120

Abstract

A laboratory course, `Introduction to Environmental Engineering Laboratory', was developed and taught incorporating teamwork in terms of conducting experiments and writing lab reports using appropriate software packages. Three Likert scale questions were asked in both midterm and final quizzes. These three questions were also used to assess three of the course learning outcomes. The data was collected based on these three questions with a Likert scale of 1 to 5. Based on the collected data, students' perceptions and attitudes toward teamwork in learning software packages and report writing appeared to be favorable and acceptable. Based on the assessment of lab report quality in terms of grammar, formatting, data analysis, and presentation of technical information, teamwork had some effect as a learning environment in terms of knowledge retention, learning software packages, and report writing skills.

Keywords

Environmental engineering laboratory, teamwork, Students' perception and attitude

Introduction

Teamwork has been defined differently by different schools of thought and different individuals but all of them zero in on one idea that team work involves people working in a group or team to accomplish a given task[1]. The term teamwork originates from the concept of a team and in simple terms refers to doing work in a team or group. According to Business Directory, teamwork has been defined as the "process by which a group of people work collaboratively to achieve a set or given goal/ task". According to this definition, teamwork means that people will try to cooperate, using their different individual skills and talents to provide constructive feedback despite the fact that individuals may have personal conflict among themselves. This definition acknowledges that teamwork brings together ideologically different people, with different skill sets for the accomplishment of a set target or goal[1].

Another definition of teamwork is a group of people with a full set of complementary skills required to complete a task, job, or project[2]. Team members (1) operate with a high degree of interdependence, (2) share authority and responsibility for self-management, (3) are accountable for the collective performance, and (4) work toward a common goal and shared rewards(s). A team becomes more than just a collection of people when a strong sense of mutual commitment creates synergy, thus generating performance greater than the sum of the performance of its individual members[2].

Now the question comes – How can one form a team with an optimum number of people? Some literature says that a team can be formed using people with different individual skills and talents as the project may need. In an education setting especially in the lab group forming, this idea may not work. A study conducted by the author[3] indicated that optimum number students in a group for lab or project work is either 3 or 4. As a result, this study was conducted using a group of students not less than 3 or not more than 4 following the findings of the study[3]. In most cases, three students formed a group. The students were given the option to form the group without any direction from the instructor.

The first goal of this study was to evaluate the students' perceptions and attitudes about teamwork in learning software packages and technical aspects of report writing in terms of grammar, format, data analysis, and presentation of technical information that could be tailored for future environmental engineering lab courses. The second goal was to assess the effect of teamwork on the process as a learning tool in terms of knowledge retention and improvement. The students were asked to pay attention to the feedback on the lab reports in terms of grammar, formatting, data analysis, and presentation of technical information and follow them closely to prepare for the future reports throughout the semester.

Type of Data Collected

Three Likert scale questions (Figure 1) were asked to students during midterm and final quizzes to gather students' perception and attitude toward learning software package and improving technical report writing skills in lab group setting. To assess the students' understanding about the teamwork to learn software package and technical report writing, the average grades for seven sets of lab reports were compiled and analyzed. Table 1 lists the experiments that were assigned and performed for each set of lab reports. The set was defined based on the number of experiments performed in one setting or in a day.

Q.1 Indicate the effectiveness of technical lab report writing in terms of experience and learning (5 being the highest). (CLO 4)

☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5**

Q.2 Indicate the effectiveness of learning modern software packages in preparation of lab reports (5 being the highest). (CLO 5)

☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5**

Q.3 Indicate the effectiveness of group work in the lab in terms of experience and learning (5 being the highest). (CLO 6)

☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5**

Figure 1: Questionnaire for teamwork effect perception and attitude

Table 1: Number of experimental sets and experiment titles used for the assessment

Set Number	Experiment Number and title
1	1. Determination of pH 2. Determination of Color 3. Determination of Turbidity
2	4. Determination of Solids 5. Determination of Carbon dioxide
3	6. Determination of Alkalinity 7. Determination of Hardness
4	8. Determination of Chloride 9. Determination of Metal Concentration
5	10. Determination of Optimum Coagulant Dose (Jar Test)
6	11. Determination of Breakpoint Chlorination
7	12. Determination of Chemical Oxygen Demand (COD) 13. Determination of Biochemical Oxygen Demand (BOD)

As mentioned, feedbacks were provided during evaluation of lab reports for grammar, format, data analysis, and presentation of technical information. The students were asked to use the feedbacks and improve the report writing. The data was collected for four semesters: summer 2017 (22 students), fall 2017 (28 students), spring 2018 (23 students), and summer 2018 (20 students). There were 93 students enrolled in the course during these four semesters and 100% of students participated in the questions asked as all the questions were mandatory with bonus points. The quizzes were conducted face-to-face and in a proctored setting. Q.1 was used to assess the course learning outcome (CLO) 4, Q.2 for CLO 5, and Q.3 for CLO 6. The CLOs are as follows:

CLO 4: Demonstrate the ability to write clear technical laboratory reports.

CLO 5: Employ modern software packages in preparing the laboratory report.

CLO 6: Demonstrate the ability to work in groups.

The data obtained from the above CLOs were also used for ABET Student Outcome (ASO) assessment.

Data Analysis, Result, and Discussion

Based on the Likert scale responses to Q.1 as to how the participants liked technical lab report writing in a group, overall 57% of the participants chose “5”, 31% chose “4”, 7% chose “3”, 2% chose “2” and, 3% chose “1”. The distribution of Q.1 responses is presented in Figure 2. Based on the choice distributions, it is obvious that maximum number of participants (more than 88% chose “4” and “5”) highly preferred to write technical lab reports in a group during the semester. All of the semester distributions closely agree with the overall distribution. This data indicates that technical lab report writing seems to be important and well perceived by the students.

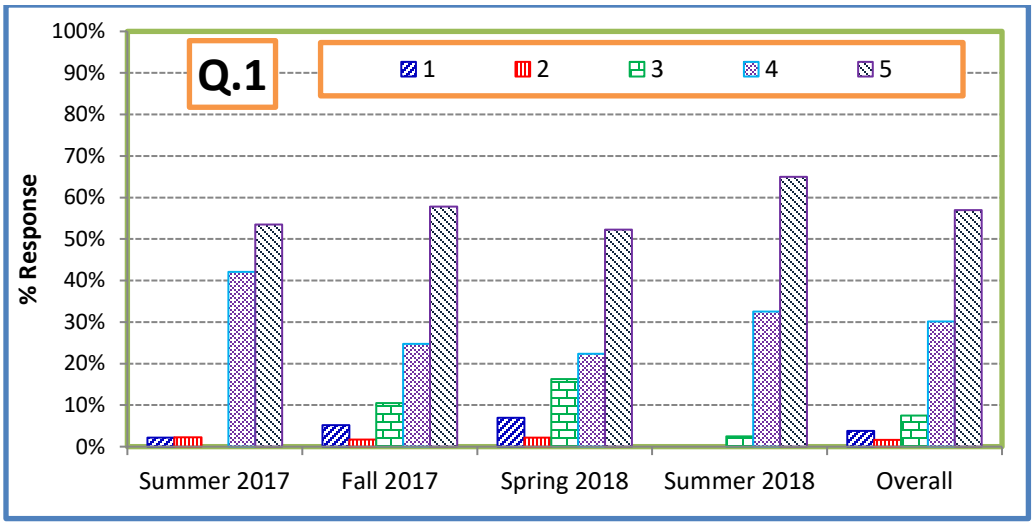

Figure 2: Distributions of choices of the participants about Q.1

Based on the Likert scale responses to Q.2 as to how the participants liked learning modern software packages in preparation of lab reports, overall 49% of the participants chose "5", 25% chose "4", 17% chose "3", 4% chose "2" and, 5% chose "1". The distribution of Q.2 responses is presented in Figure 3. Based on the choice distributions, it is obvious that maximum number of participants (more than 75% chose "4" and "5") highly preferred learning modern software packages through the lab report writing in a group work setting during the semester. All of the semester distributions closely agree with the overall distribution. This data indicates that learning modern software packages through lab report writing seems to be important and well perceived by the students.

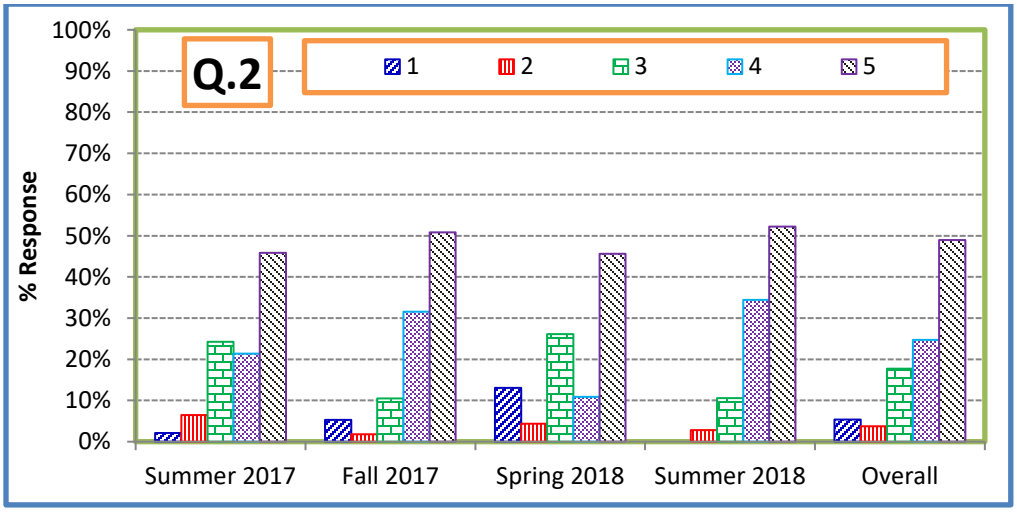

Figure 3: Distributions of choices of the participants about Q.2

Based on the Likert scale responses to Q.3 as to how the participants liked effectiveness of group work in the lab in terms of experience and learning, overall 64% of the participants chose "5", 23% chose "4", 9% chose "3", 2% chose "2" and, 3% chose "1". The distribution of Q.3 responses is presented in Figure 4. Based on the choice distributions, it is obvious that maximum

number of participants (more than 87% chose "4" and "5") highly preferred to work in group for overall learning and experience. Most of the semester distributions agree with the overall distribution with summer 2018 having the higher responses. This data indicates that a group work seems to be very effective in overall learning experience and well perceived by the students.

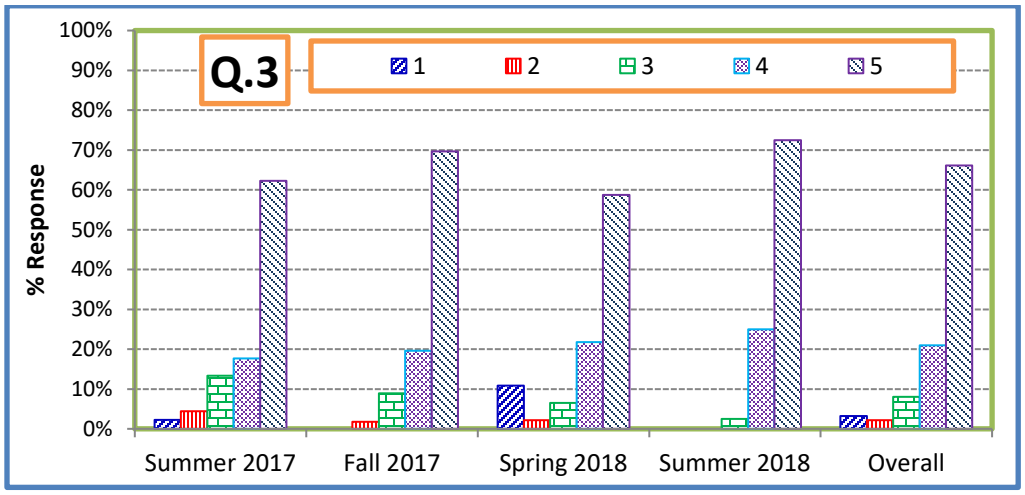

Figure 4: Distributions of choices of the participants about Q.3

The weighted averages of Likert scale choices are presented in Figures 5 thru 7. As seen in Figure 5, this analysis was performed to understand the students' perception and attitude toward technical lab report writing in a group. The total overall weighted average was 4.35. The weighted average for the four semesters varied from 4.11 to 4.63, with the highest score for summer 2018. This could be due to the reason that the instructor was able to provide better guidance and clear instructions about the expectations with the experience gained from the previous semesters.

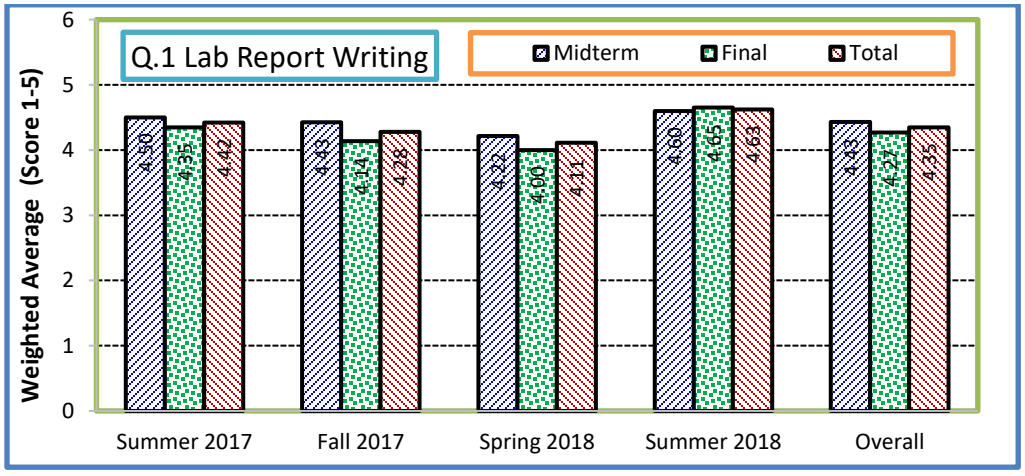

Figure 5: Distributions of weighted average of the choices of the participants about Q.1

As seen in Figure 6, this analysis was performed to understand the students' perception and attitude about learning modern software packages in preparation of lab reports in a group. The

total overall weighted average was 4.07. The weighted average for the four semesters varied from 3.72 to 4.37, with the highest score for summer 2018. This observation seems to be consistent with the explanation in Q.1.

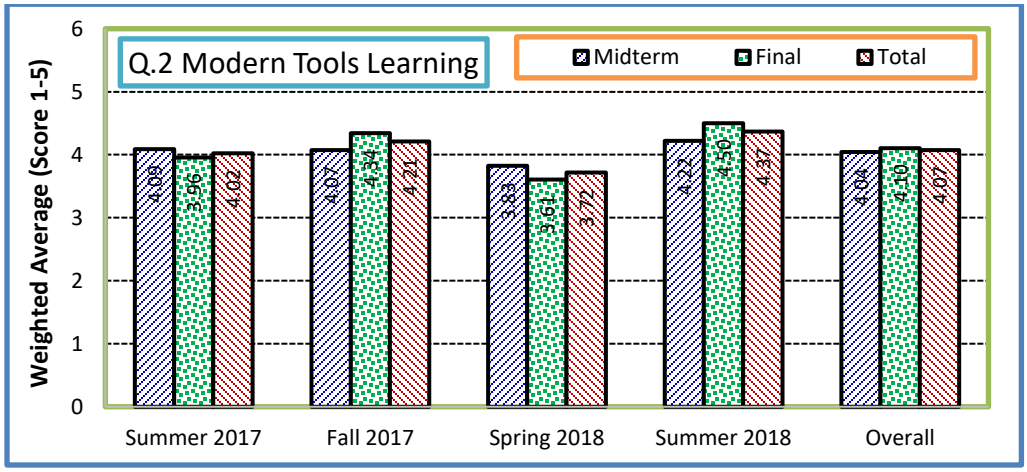

Figure 6: Distributions of weighted average of the choices of the participants about Q.2

As seen in Figure 7, this analysis was performed to understand the students' perception and attitude about effectiveness of group work in the lab in terms of experience and learning. The total overall weighted average was 4.44. The weighted average for the four semesters varied from 4.15 to 4.70, with the highest score for summer 2018. This observation is also consistent with Q.1 observation and could be due to the same reason as explained for Q.1.

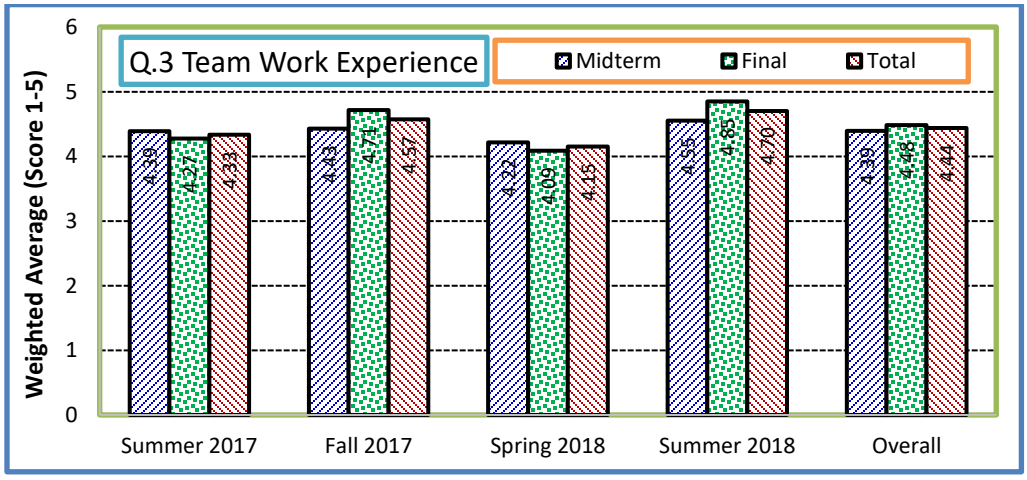

Figure 7: Distributions of weighted average of the choices of the participants about Q.3

An assessment was done based on the average scores of the seven sets (Table 1) of lab reports to see the improvements in lab report writing in terms of grammar, format, data analysis, and presentation of technical information with time throughout the semester for four semesters. The assessment is shown in Figure 8. The best-fit linear trend line was added to see whether the quality is increasing, decreasing, or remaining the same. As seen in Figure 8, the trend lines for all four semesters show positive slopes indicating that the quality of lab report writing increased with time, which was the main intent of this study. The performance in set 4 seems to be

significantly high compared to other sets. This could be due to the type of experiments the students performed and the experiments under this set were short and the data was well organized. The data in Figure 8 should have been compared with data for a control section. Unfortunately no control section was taught for the comparison purpose.

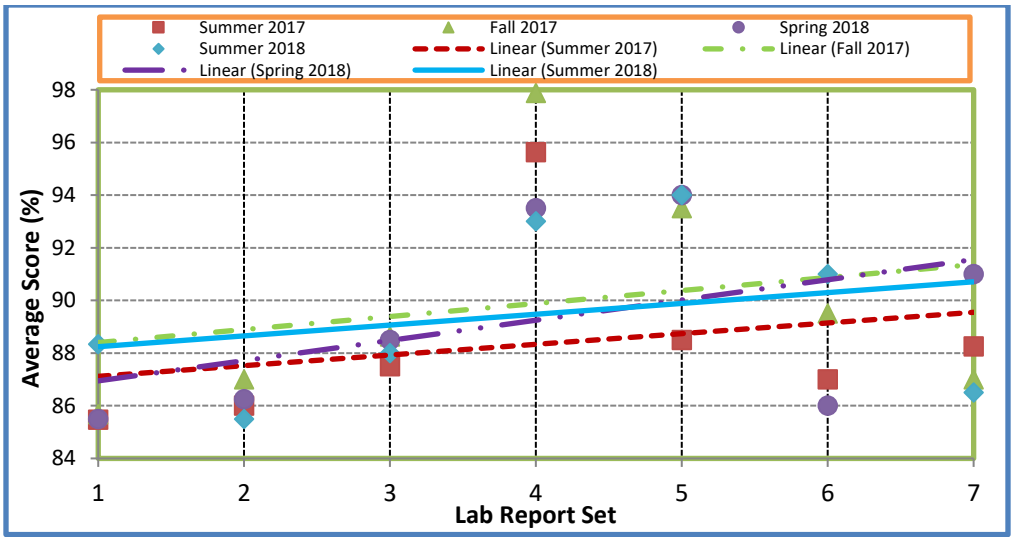

Figure 8: Trend analysis of lab report average scores for four semesters

Summary and Conclusions

In this paper, an effort was made to assess the perceptions and attitudes of students as well as understanding the importance of group work in learning software packages and technical aspects of report writing in terms of grammar, formatting, data analysis, and presentation of technical information that could be tailored for future environmental engineering lab courses as well as to assess the effect of teamwork on the process as a learning tool in terms of knowledge retention and improvement. The course, `Introduction to Environmental Engineering Laboratory', was developed and taught incorporating rigorous lab report writing in a group. In this course set up, three Likert scale questions were included in midterm and final lab quizzes. The data was collected based on these three questions with a Likert scale of 1 to 5. Based on the collected data, students' perceptions and attitudes toward teamwork in learning modern software packages and report writing skills appeared to be favorable and acceptable. Based on the assessment of lab report quality in terms of grammar, format, data analysis, and presentation of technical information, teamwork had a definite effect as a learning environment in terms of knowledge retention, learning modern software packages, and report writing skills. The lesson learned is that teamwork can be an important practice in learning modern software packages and improve technical report writing skills with proper guidance and direction by a lab instructor.

References

1. http://teamworkdefinition.com/ accessed on August 24, 2018.
2. http://www.businessdictionary.com/definition/team.html accessed on August 24, 2018.

3. Karim, M. A. ***Project Based Learning of Environmental Engineering: A Case Study***, Proceedings of 122nd ASEE Annual Conference & Exposition, Seattle, Washington, June 14-17, 2015.

M. A. Karim

Dr. M. A. Karim spent about six years as a full-time faculty at Bangladesh University of Engineering and Technology (**BUET**) after his graduation from the same university in 1989. He came to USA in 1995 and finished his Ph.D. in Civil/Environmental Engineering from Cleveland State University in 2000. He worked about three years for ALLTEL Information Services in Twinsburg, Ohio as an Applications Programmer. Then he worked about eight years (in two different times) for the Virginia Department of Environmental Quality (**VDEQ**) as a Senior Environmental Engineer and taught at Virginia Commonwealth University (**VCU**) as an Affiliate Professor before he went to Trine University in January 2008, as a full-time Assistant Professor of Civil & Environmental Engineering. He taught part-time at Indiana University-Purdue University Fort Wayne (**IPFW)** while employed at Trine University. During his time at Trine University he taught an online course for VCU. He also taught at Stratford University, Richmond, Virginia campus as an adjunct faculty while working for VDEQ. Since fall of 2011, Dr. Karim has been working for Kennesaw State University, Marietta Campus, Georgia as a full-time faculty in Civil and Construction Engineering. He is a registered professional engineer for the State of the Commonwealth of Virginia and the state of Georgia. He has more than twenty five journal and proceeding publications and three professional reports in the area of soil and sediment remediation, environmental management, statistical hydrology, project-based learning (PBL), and engineering education. He is a member of American Society of Civil Engineers (ASCE) and American Society for Engineering Education (ASEE). He is also an ABET EAC Program Evaluation Volunteer (ABET EAC PEV) for CE program. Currently Dr. Karim is an associate professor of civil engineering and assistant department chair of Civil and Construction Engineering Department at Kennesaw State University.