

GIFTS: Improved Team Skill Development through a Semester-Long Teamwork Report

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Introduction

This Great Ideas For Teaching (and Talking With) Students paper describes a novel approach to introducing and assessing teamwork in a first-year engineering program. Teamwork is a fundamental element of ABET accreditation which requires engineering programs to demonstrate and assess their commitment to fostering teamwork skills in students. This first-year engineering program aims to address this ABET criteria, as well as satisfy the university's written composition general education requirement in their engineering communications course. As part of the general education requirement, students must engage in researching a topic, constructing a well-structured argument with supporting evidence, and demonstrating effective college-level written communication that can inform, persuade, or engage with a specific audience. Additionally, students will showcase proficiency in revising and enhancing their written communication skills throughout the process. A previous assignment designed for these purposes required students to research teamwork and write a 5-page essay on it during the first few weeks of their college career. This assignment failed to convey the true importance of teamwork skills and the relevance to their own teaming situation, resulting in the sense that it was only busy work assigned to satisfy the general education requirement. The main objectives of the new assignment are to improve both cognition, or the core mental processes required for productive teamwork, and metacognition which involves empowering individuals and teams to monitor, evaluate, and adjust their cognitive strategies; the result ultimately contributing to the development of effective team skills and improved team performance.

To do this, students are engaged in a semester-long process of applying and assessing team skills. They report this information as it becomes relevant by writing a "Teamwork Report" in three phases throughout the semester. Phase 1 is assigned the first week and includes an APA-formatted title page and an introduction to teamwork. In this phase, students are given a list of teamwork resources and use them to write about which characteristics make for a good team and team member. Additionally, students take a strengths test [1] and share their top five strengths with their team members. Although these characteristics are advertised as strengths, they can have a negative impact if left unchecked or are not expressed in conjunction with other team members' strengths; therefore, students also hypothesize how their own strengths may help and hinder teamwork and how their team members' strengths may help and hinder teamwork. Project teams are required to complete two projects during the semester, and Phase 2 is assigned between those two projects. At this point, teams have a team debrief for roughly 45 minutes during class time where they systematically give and receive teamwork-related feedback to each team member. Students come to class prepared with discussion points and in the proper mindset to have difficult and respectful discussions. Afterward, students complete an action plan where they identify team skills they want to improve and how to work towards that goal. Moreover, students take a personality test [2] and discuss their results, including communication tips, with their team. Using this information, students write Phase 2 which describes all the methods used to assess teamwork and personal development, as well as the results section explaining how the initial hypotheses were supported or contradicted using evidence from the first project, their action plan, and their personality test results with strategies to improve their communication

during the second project. Phase 3 is introduced after the second project is complete and requires teams to have one more team debrief. They discuss and report changes in their teamwork between the two projects, changes to their personal teamwork skills, and their self-perception versus the perception of their teammates. They end by writing a conclusion where they summarize how their self-awareness and understanding of others changed throughout the process and how this exercise can help them in the future. A references page for the entire report is also included in Phase 3. Students have two weeks to complete Phase 1 and Phase 2 and one week to complete Phase 3. All three phases are graded on content, format, composition, and proper use of citations using a detailed set of guidelines and rubrics. A template and in-text and reference page citations are given for the provided teamwork sources, as formatting of documents and references are taught at a later point in the program. All materials are available to instructors and students throughout the semester and are shown in Appendix A.

The main aim of this study is to understand student perceptions of the assignment and its usefulness. Secondary aims include determining whether students were successful in improving their work on the Teamwork Report assignment throughout the semester and if the grading criteria are consistent and appropriate for the course.

Project Approach

The main objective is to analyze student perceptions of the assignment and its usefulness. This will be analyzed using qualitative feedback from students from the Conclusion section of their Teamwork Reports. This section asks students to provide a clear and concise summary of how self-awareness and understanding of others have changed throughout the semester by going through this process and to provide a thoughtful conclusion on how this exercise can help them in the future. Reports were reviewed from four engineering communications sections, each taught by a different instructor, from the Fall 2023 semester for a total of 89 reports. Notes were taken on anything that students indicated to be useful about the assignment, including things they learned, applied, reflected on, etc.

The secondary aims of the study will be addressed using quantitative data collected from first-year engineering students enrolled in the engineering communication course at *university* during the Fall 2021, Fall 2022, and Fall 2023 semesters. Phase 1, Phase 2, and Phase 3 grades from the Teamwork Report assignment will be analyzed using descriptive statistics to observe trends in grades on the assignment over the semester. This is an introductory engineering course and the average course grade is expected to be an A- which is in the range of 90.0 to 94.9. Therefore, students' Overall Teamwork Report Grades and Course Grades will be compared to the A- grade range that is desirable for the course.

This study was issued an exempt approval waived under Section 45 CFR 46 104(d)(4) of the Code of Federal Regulations.

Results and Discussion

Students' perceptions of the usefulness of the Teamwork Report assignment and the process it required them to undergo were overwhelmingly positive and insightful. Many stated that the strength [1] and personality [2] tests helped identify strengths, weaknesses, and areas of

improvement in themselves and their teammates. Additionally, these tests were beneficial for recognizing, understanding, and appreciating the diverse perspectives, personalities, and communication styles within their team. Many stated that their emotional intelligence and empathy towards team members also improved throughout this process. Students expressed growth as team members and overall people from this process and that the skills learned would carry over into their future teams and careers. In a few cases, students expressed that they had a reserved demeanor and did not speak up with their team or they were taken advantage of by their team. In these cases, those students expressed how they planned to improve upon this in their next team setting.

On a team level, this exercise was found to be useful in improving communication skills, including active listening, honest and open expression, and respectful discourse. Students expressed improved ability at resolving conflict and creating a team environment with psychological safety that fostered open-minded conversations. Furthermore, many expressed an improvement in their leadership capabilities and their ability to adapt to different personalities and work styles within a team. Many students specifically mentioned the team debrief that took place between the two projects where teams are given intentional time to resolve conflict in class. This activity helped them recognize the importance of self-reflection and feedback for both personal and team development.

It is important to note that students were prompted to describe how their self-awareness and understanding of others changed throughout the semester by going through this process and to provide a thoughtful conclusion on how this exercise can help them in the future which could have created bias in the responses. To help account for this, responses that generically answered the prompt were not included in the analysis. Furthermore, students frequently described their experiences using words and themes that were only mentioned in the teamwork resources provided in Phase 1. That is an indication that the assignment was successful at encouraging students to apply the fundamentals of teamwork they learned in Phase 1 to their team experience throughout the semester. Moreover, the main objectives of the Teamwork Report are to improve the core mental processes required for productive teamwork and empower individuals and teams to monitor, evaluate, and adjust their cognitive strategies to improve teamwork. Many students' responses indicate that these were accomplished and resulted in the development of effective team skills and improved team performance.

Regarding the secondary aims, the data supports the idea that students were able to improve on the Teamwork Report assignment throughout the semester, which is one of the goals of the assignment. Table 1 shows that mean grades increased by 3.25% from the Phase 1 to the Phase 3 submission when all students were considered and by 3.58% when only the students who submitted all three phases were considered. The overall improvement in students' grades from Phase 1 to Phase 2 to Phase 3 could be due to many reasons, including making changes in response to earlier feedback, the content of progressing phases being less difficult, or students being more acclimated to college studies.

The analysis revealed that 54 students (5.20%) failed to submit some portion of the Teamwork Report. This group may have benefitted from the structure of the Teamwork Report being broken

down into three phases where a smaller portion of their overall course grade was sacrificed when they failed to submit a phase (roughly 5% per phase), compared to the original teamwork essay that was completed all at once and worth 15% of the overall course grade. In the future, instructors could provide additional encouragement to the students who fail to submit a phase, so they may be more likely to submit future phases.

Table 1: Descriptive statistics for the Phase 1, Phase 2, Phase 3, and Overall Teamwork Report Grades from first-year engineering students in the engineering communication course during the Fall 2021, Fall 2022, and Fall 2023 semesters (N=1038). The same statistics are shown when outliers are removed for students who failed to submit a portion of the Teamwork Report (n=984).

Variable	N	Mean	StDev	Median	n	Mean	StDev	Median
Phase 1 Grade	1038	90.68	12.66	94.08	984	91.79	9.13	94.67
Phase 2 Grade	1038	89.53	18.74	95.43	984	92.71	9.10	95.71
Phase 3 Grade	1038	91.85	18.29	97.14	984	95.08	7.49	97.14
Overall Teamwork Report Grade	1038	90.69	13.25	94.53	984	93.27	6.03	95.00

Lastly, the grading criteria were found to be consistent and appropriate for the course based on the desired average grade of an A- or 90.0 to 94.9. When all students were considered, the mean Overall Teamwork Report Grades ranged from 90.00 to 91.00, and the median ranged from 93.80 to 95.50 (Table 2) which is consistent with the A- range. Additionally, the mean Course Grades ranged from 93.12 to 93.29 and the median ranged from 94.52 to 94.92 (Table 2) which is also consistent with the A- range.

Table 2: Descriptive statistics for the Overall Teamwork Report and Course Grades from first-year engineering students in the engineering communication course during Fall 2021 (n=350), Fall 2022 (n=352), and Fall 2023 (n=336) semesters.

Variable	Year	N/n	Mean	StDev	Median
Overall Teamwork Report Grade	2021	350	91.00	14.30	95.50
Overall Teamwork Report Grade	2022	352	91.03	12.95	94.50
Overall Teamwork Report Grade	2023	336	90.00	12.43	93.80
Overall Teamwork Report Grade	All	1038	90.69	13.25	94.53
Course Grade	2021	350	93.29	5.96	94.92
Course Grade	2022	352	93.17	5.95	94.74
Course Grade	2023	336	93.12	6.77	94.52
Course Grade	All	1038	93.19	6.23	94.72

Overall, the Teamwork Report assignment was found to be effective in introducing students to teamwork concepts and having them apply those concepts to their project team. The student responses and grades support the current structure of the assignment and its grading criteria. This assignment can be translated to other similar programs to aid students in developing effective team skills that will benefit them in their future studies, relationships, and careers.

References

- [1] HIGH 5 TEST, "HIGH 5 TEST," 23 August 2022. [Online]. Available: <https://high5test.com/>.
- [2] Humanmetrics Inc., "Jung Typology Test™," 23 August 2022. [Online]. Available: <https://www.humanmetrics.com/personality>.

Appendix A:

Teamwork Report – Overview

You will review existing literature, complete self-assessments, team evaluations and have team discussions to better understand and apply concepts related to teamwork. This is an opportunity for you to assess your own personality and team skills in order to personally develop throughout the semester. Additionally, team discussions will help you understand the differences in how you perceive yourself compared to how your team members perceive you.

This report will be completed in 3 phases throughout the semester and fulfills part of the Composition general education requirement for the course. Although your team will discuss things related to the report, the report itself will only be read by the instructor and UCAs. You will receive instructor/UCA feedback after each phase.

Caution while using ChatGPT or other AI software: Although it is a useful tool, using it as a substitution for your own writing is plagiarism! If you choose to use it, do so responsibly and appropriately as described in this video: <https://youtu.be/fdia7oL3Ocl>

Make sure to use the provided in-text citations throughout your report. Include an in-text citation when you refer to, summarize, paraphrase, or quote another source. Failure to do so is considered plagiarism and will result in a 0 for the assignment and the submission of an academic honesty report. The in-text citations are shown in parentheses as (author, year) throughout this document.

Before Writing Phase 1:

1. Read/listen and take notes on the provided sources about teamwork and things that influence how a team performs.
 - [Are you an ideal team player?](#) (Lencioni, 2020)
 - [What makes a successful team?](#) (Sime, 2019)
 - [15 top tips to become a better team player at work](#) (Forbes Coaches Council, 2018)
 - [How to do team research](#) (Shneiderman, 2016)
 - [The secrets of great teamwork](#) (Haas & Mortensen, 2016)
 - [The new science of building great teams](#) (Pentland, 2012)
 - [How to turn a group of strangers into a team](#) (Edmondson, 2017)
2. Take the [HIGH5 TEST](#) (High5, n.d.) and put the results in your team's shared Team Contact Information Spreadsheet.
3. Review the APA in-text and reference page citations for the provided sources.

Complete Phase 1 using the rubric on page 2. Do not start Phase 2 or 3 until instructed to do so.

Before Writing Phase 2:

1. Take the [Jung Typology Test](#) (personality test) and put the results in your team's shared Team Information Spreadsheet (Jung & Briggs, n.d.).
2. Complete the "Action Plan Worksheet" Google Form (Carr et al., 2005).
3. Have team debrief.
4. Review the APA in-text and reference page citations for the provided sources.

Complete Phase 2 using the rubric on page 3. Do not start Phase 3 until instructed to do so.

Before Writing Phase 3:

1. Have team debrief.
 2. Review the APA in-text and reference page citations for the provided sources.
-

Teamwork Report – Phase 1 Rubric

Format: ___/1

- ___/0.4 Double-spaced, 12-point Times New Roman font, 1" margins all around, page numbers
- ___/0.4 Heading levels follow APA guidelines (i.e. Level 1: centered, boldface; Level 2: left-aligned, boldface; Level 3: Left-aligned, boldface italic)
- ___/0.2 Indented paragraphs. No spaces between paragraphs or headings.

Composition: ___/4

- ___/2 Carefully edited for grammar, spelling, and syntax.
- ___/2 Clear and logical transitions between paragraphs and logical overall organization.

In-text Citations: ___/2

- ___/2 Correct use of APA in-text citations.
-

Title Page (~1 pg): ___/3

- ___/3 Includes a title (Teamwork Report), your name, name of department and university, course # and name, and the instructor's name according to APA format (see template).

Introduction (~2 - 3 pgs): ___/20

REMINDER: Use the provided in-text citations throughout your report. Include an in-text citation when you refer to, summarize, paraphrase, or quote another source. Failure to do so is considered plagiarism and will result in a 0 for the assignment and the submission of an academic honesty report. The in-text citations are shown in parentheses as (author, year) throughout this document.

Teamwork Overview (~ ¾ - 1 pg)

- ___/1 Compelling opening sentence that makes it clear why the topic is important.
- ___/3 Summary of the main elements of teamwork using information from **at least 3** of the provided sources.
- ___/2 Includes information about what makes for a good TEAM.
- ___/2 Includes information about what makes for a good TEAM MEMBER.

Personal Assessment (~ ½ - 1 pg)

- ___/2 Summary and definitions of your own strengths from the High5 Test.
- ___/2 Prediction of how you **THINK** your strengths may **HELP** teamwork based on the HIGH5 TEST results and information from the provided sources.
- ___/2 Prediction of how you **THINK** your strengths may **HINDER** teamwork based on the HIGH5 TEST results and information from the provided sources.

Team Assessment (~ ¾ - 1 pg)

- ___/2 Summary and definitions of your other team members' strengths from the High5 Test.
 - ___/2 Prediction of how you **THINK** your team members' strengths may **HELP** teamwork based on the High5 Test results and information from the provided sources.
 - ___/2 Prediction of how you **THINK** your team members' strengths may **HINDER** teamwork based on the High5 Test results and information from the provided sources.
-

Total: ___/30

Teamwork Report – Phase 2 Rubric

Format: ___/1

___/0.4 Double-spaced, 12-point Times New Roman font, 1" margins all around, page numbers

___/0.4 Heading levels follow APA guidelines (i.e. Level 1: centered, boldface; Level 2: left-aligned, boldface; Level 3: Left-aligned, boldface italic)

___/0.2 Indented paragraphs. No spaces between paragraphs or headings.

Composition: ___/4

___/2 Carefully edited for grammar, spelling, and syntax.

___/2 Clear and logical transitions between paragraphs and logical overall organization.

In-text Citations: ___/2

___/2 Correct use of APA in-text citations.

Methods (~1 - 2 pgs): ___/10

Clearly explain each of the following methods used to assess teamwork and personal development. For each method, include the frequency it is used, who is involved, what it evaluates and if it is used to monitor personal and/or team development.

___/2 *Team Meeting Minutes*

___/2 *Team Evaluation Google Form*

___/2 *Team Meetings* (both in and out of class)

___/2 *Team Debriefs* (One between RE and Arduino projects and another after the Arduino project)

___/2 *Self-Assessments* (High5 Test, Jung Typology Test and Action Plan Worksheet)

Results (~1 - 2 pgs): ___/18

___/7 Clear explanation of how teamwork during the Reverse Engineering Project supported or contradicted your initial predictions from the Introduction section. Use evidence and specific examples obtained from your evaluation methods previously described (i.e. Team Meeting Minutes, Team Evaluation Google Form, and Team Meetings).

___/4 Explanation of the team skills that you need to improve based on the Action Plan Worksheet and team feedback from the Team Debrief.

___/7 Summary of Jung Typology Test results as they relate to working and communicating in a team. What is your personality type? What aspects of your personality do you need to be aware of when working in teams? Using the communication tips from the assessment results, how can you change the way you personally communicate to work better with your teammates' personalities?

Total: ___/35

Teamwork Report – Phase 3 Rubric

Format: ___/1

___/0.4 Double-spaced, 12-point Times New Roman font, 1" margins all around, page numbers

___/0.4 Heading levels follow APA guidelines (i.e. Level 1: centered, boldface; Level 2: left-aligned, boldface; Level 3: Left-aligned, boldface italic)

___/0.2 Indented paragraphs. No spaces between paragraphs or headings.

Composition: ___/4

___/2 Carefully edited for grammar, spelling, and syntax.

___/2 Clear and logical transitions between paragraphs and logical overall organization.

In-text Citations: ___/2

___/2 Correct use of APA intext citations.

Discussion (~¾ - 1 pg): ___/20

___/6 Discussion of any changes in teamwork between the Reverse Engineering and Arduino Projects.

___/6 Explanation of any changes to your personal team skills throughout the semester.

___/8 Discussion of self-perception versus perception by teammates. What new things did you learn about yourself and how others perceive you? Were you surprised by anything?

Conclusions (~½ - ¾ pg): ___/5

___/3 Clear and concise summary of how self-awareness and understanding of others has changed throughout the semester by going through this process.

___/2 Thoughtful conclusion on how this exercise can help you in the future.

References (~1 pg): ___/3

___/3 APA Reference page at the end of the report that includes citations for every source cited in the body of the report.

Total: ___/35