

Building Engineering Professional and Teamwork Skills: A Workshop on Giving and Receiving Feedback

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Introduction

This paper describes the fourth out of a series of six workshops on teamwork targeted at undergraduate engineering students. The series has been designed to provide teamwork theory and skills in the context of an existing team project within a course, allowing the new knowledge and skills to be applied authentically and at the time of learning. The experiential workshops consist of three introductory workshops (Team Membership and Coordination, Team Communication, and Understanding Conflict), two reinforcement workshops (Giving and Receiving Feedback, and Conflict Resolution), and one mastery workshop (currently in development). Each workshop has the flexibility to run in either 50 or 80 minutes, with delivery occurring during class or lab time. Modules typically consist of a short slide presentation along with hands-on activities that allow students to apply and practice their new skills. These workshops are most impactful when integrated into courses that have students working in teams on lengthy, course-specific projects. Additionally, a number of assessment strategies have been developed in order to assess student learning and the overall success of the workshops.

The fourth workshop developed as part of this series on teamwork focuses on giving and receiving feedback. At the end of this workshop, students should be able to:

- 1) Understand the value of seeking, giving, and receiving feedback for themselves, their team, and as a professional;
- 2) Apply communication skills that keep feedback from becoming personal, both as a giver and as a receiver of feedback; and,
- 3) Give feedback that integrates various types of functions, which includes understanding, assessing, and providing recommendations.

The workshop has been effectively implemented in multiple offerings of engineering design courses, both at junior and capstone levels. In those settings, the workshop provides students with an opportunity to learn about and practice giving and receiving feedback on peers' project plans, and chosen design methods and artifacts.

In the remaining sections of this paper, we describe the contents of the workshop in detail and summarize student feedback on each implementation. Further, we reflect on how the workshop can be further developed to better meet its intended learning outcomes and suggest ways in which instructors can alter it to suit different student disciplines, academic levels and course objectives.

Importance of Feedback

Feedback is reaction or opinion regarding a product, the performance of a task, etc., that is used to support improvement or confirm success. The education literature distinguishes between formative and summative feedback. While in academic settings both types of feedback are typically provided by instructors, studies have shown that formative feedback provided by student peers has many benefits. When students review their peers' work they engage in the cognitive processes of analysis, diagnosing problems, and suggesting solutions. Similarly, when feedback is utilized within a team setting, it supports the project goals by assessing the project's current state, which tends to positively impact team effectiveness [1], [2].

Giving and receiving feedback effectively improves students' ability to work collaboratively. Specifically, Nicola et al. [2] suggest the following behaviors can improve team performance: i) accepting feedback and ideas from others, ii) avoiding person-oriented feedback and focusing on task-focused feedback, iii) providing specific and constructive suggestions when providing feedback, and, iv) basing feedback on facts instead of opinions. Furthermore, the overall quantity of feedback received by the learner is increased when peer review is included alongside the instructor's review. In fact, the greatest benefit is obtained by receiving feedback from multiple peers. This exposure to feedback from multiple individuals can also introduce a level of heterogeneity that fosters increased critical thinking, innovation and the ability to understand different perspectives [2]. Finally, peer feedback can be perceived as being more helpful than instructor feedback because it is typically delivered in a manner more readily understood by the receiver [2].

The review process, particularly peer-to-peer review, is important to the success of engineering design projects. Working professionals will encounter collaborative situations where feedback is given and received as part of the design process. This can include a variety of parties, including peers, supervisors and clients. Teams with leaders that have received training on engaging feedback and critique processes outperform those who lack such training [2]. While feedback in a team setting can certainly help to ensure the final product is thoughtfully considered and creative, providing constructive feedback tends to prove challenging as it can impact individual beliefs about self-worth, personal ability [1] and motivation [3]. The attribution of the feedback outcome (whether success or failure) to oneself or another member rather than to the product or process has the potential to distract these individuals from the ultimate project goals.

From an educational or learning standpoint, providing a framework or categorization when learning new concepts can support the development of the associated skills. When it comes to the categorization of feedback, Hurst and Nespoli [4] encourage conscious consideration of the following three types: interpretation/comprehension, evaluation, and recommendation. Studies

have shown that, while instructors are able to provide balanced feedback that seeks to comprehend the design, provide an assessment, and suggest improvements, students are typically not comfortable providing evaluation- or recommendation-type feedback to their peers. Instead, their assessments and suggestions are made implicit in the questions they pose [5]. Students may have difficulties in providing and receiving feedback; they could worry about being distinguished from their peers, being portrayed as incompetent, or fear that they may offend another person. Understanding the importance of feedback and the value of its various types can help students practice and reinforce these cognitive processes, enabling them to develop their confidence in giving feedback and empowering them to produce good quality work themselves.

Workshop Series Overview

All workshops in the series have been intentionally developed to ‘wrap’ around existing team projects in a course and can easily be adjusted to align with the most logical time in the teamwork process depending on the nature and requirements of the project. This approach helps to ground the new skills in an authentic learning environment, enabling students to immediately practice what they have learned and improve their team’s performance. In addition, instructors tend to respond positively to the alignment of the workshop with their existing course activities. This is primarily because the session seeks to develop their existing project rather than introducing a standalone workshop that is focused on improving student skills but which may not directly impact the quality of the final projects.

As mentioned above, the instructional design of the workshops is based on the principle that teamwork skills are best learned through practice in a real-world setting. The design is underpinned by Merrill’s First Principle of Instruction [6] which suggests the following five phases for instructional design:

- 1) Task centered: *learning is promoted when learners are engaged in solving real-world problems,*
- 2) Activation: *learning is promoted when existing knowledge is activated as a foundation for new knowledge,*
- 3) Demonstration: *learning is promoted when the new knowledge is demonstrated to the learner,*
- 4) Application: *learning is promoted when new knowledge is applied by the learner, and*
- 5) Integration: *learning is promoted when new knowledge is integrated into the learner’s world.*

If we tease apart the module according to Merrill’s principles, learners have the opportunity to solve real-world problems as the workshops are integrated alongside existing team projects.

Activation is achieved as the workshops build on one another from introductory to reinforcement to mastery levels. Additionally, knowledge from previous workshops is referenced and built upon in subsequent ones. Demonstration principle occurs in this workshop by including example interpretation, evaluation and recommendation phrases that are related to the project in the presentation that introduces the feedback model and activities. The students then have an opportunity to practice applying the new skills in class with support from the facilitators. Post-project reflection questions encourage the continual integration of the new knowledge and skills into the students' teamwork practices.

“Giving and Receiving Feedback” Workshop Design

Pre-Class Preparation: Students complete a pre-survey in the course learning management system prior to attending the in-class session (the complete survey is omitted here due to space considerations, but the authors will be happy to provide a copy on request). The purpose of this survey is to encourage students to critically think about giving and receiving feedback. The survey asks students to select the top three considerations from a provided list of 14 options (for example, “Avoiding personal comments”, “Supporting ideas with facts”) in four contexts of giving or receiving feedback that is either positive or constructive in nature. These are followed by two text response questions asking: “What is the biggest challenge for you in giving feedback to another person/team member?” and “What is the biggest challenge for you in receiving feedback from another person/team member”

This information from the survey can be used to adjust in-class examples and the introduction section to better address any outstanding concerns or themes that may arise from the responses.

Workshop Introduction: The session begins with a discussion on the value of feedback from a personal, professional, and team perspective. The facilitator is encouraged to draw on their own anecdotal stories and experiences to enhance this material. This section also addresses possible reasons why the feedback process can be a difficult or uncomfortable one for some individuals.

Next, the facilitator introduces a feedback model to help support the development of feedback skills. The model encourages progression through the three types of feedback identified by Hurst and Nespoli [4]. According to the model, the first feedback stage is interpretation, where the feedback-giver summarizes or paraphrases to check understanding, as well as asks questions to clarify information and to expand their understanding beyond what has been presented. They can then follow up on this by providing positive and constructive evaluations of the idea, document, or artifact under review, using examples to support their evaluations (when appropriate). Finally, in the recommendation phase, the feedback-giver provides practical and realistic suggestions to

help guide the design from its current state toward the desired state. They are encouraged to provide their recommendations with specific and clear details that are supported by facts. Communication skills such as tone of voice, body language and avoiding personal comments, are emphasized at each stage of feedback.

Idea Generation: Next, student teams are asked to come together to prepare for the Gallery Critique activity, the main activity used to practice giving and receiving feedback. Depending on the type of project that the module is integrated in, and the time available, several options are offered for the idea generation phase, including:

- **Brainstorming in Pairs:** The project teams (ideally groups of four) split into two sub-teams and brainstorm as many ideas as possible. Each sub-team then works together to select their top idea for the Gallery Critique activity.
- **Generating Eight Ideas in Five Minutes:** Students work individually to do this and the top idea is then selected to display in the Gallery Critique activity. This process is drawn from the Google Design Sprint [7].
- **Individual Idea Generation:** Students develop their ideas outside of this time and come to class prepared with their best idea for the Gallery Critique activity.

Gallery Critique Activity: The Gallery Critique activity begins with students posting a visualization of their idea. The Gallery Critique Activity does not provide time to pitch the ideas before critique so all ideas should be displayed in a written or graphical format for presentation. The first step is for students to review the work presented and take part in heat mapping. Students are given time to read each of their teammates' presented solutions. This time is meant for reading and reviewing the solution and students are discouraged from talking during this time. Then, each member is given colored dot stickers or colored pens/markers and are instructed to mark the best solution or components within the solution. An accumulation of several stickers/dots of a particular color can indicate enthusiastic agreement while concerns or questions about a solution component can be noted by a different color dot or can be documented on a sticky note placed by the solution.

Next, each solution is critiqued by the other members who are prompted to follow the feedback process of asking clarification questions to improve their comprehension of the design, using examples to provide positive and constructive evaluations, and finally, suggesting practical and realistic solutions that will help to advance the design to the desired state. Each member is encouraged to participate in the feedback process so that they can practice the new skills while supporting their teammates. Once the Gallery Critique activity has been completed for each of

the proposed ideas the team should come together to discuss the critiques in order to develop their next steps.

Deliverables: Students are then prompted to individually complete a “receiving feedback” self-assessment, which asks them to rate their behavior on various scales such as listening attentively and openness to feedback and new opportunities, among others, in order to determine areas of potential improvement. Teams are also asked to answer a series of questions regarding the value of the skills learned, the impact of the workshop on their final solution, and how the skills were integrated throughout the remainder of the team’s work.

Implementation and Flexibility

The design of the workshop provides flexibility in allowing the instructor to adapt it to their particular course or project. Several implementations are described below.

The workshop was implemented twice in a management engineering capstone design project series of courses. In one implementation, it was delivered just after the mid-point of the design process, as students were creating detailed design verification plans. In this case, the “concepts” on which the students sought peer feedback were different ideas they had come up with to verify their designs. In the other implementation, the workshop was delivered about one-third of the way through the design process, once students had completed their problem formulation phase and had begun creating a number of different conceptual designs to address the identified need.

The workshop was also implemented in a second-year mechanics course as part of a course project in which the students had to design a playground for local schools in the community. The workshop was delivered to the students at the midpoint of the course project, just after the instruction team gave them feedback on their preliminary designs. During the workshop, the students were able to give each other feedback on their preliminary designs and reflect on this feedback. Students stated that this workshop was beneficial for them in finalizing their design. They also used the feedback techniques developed in the workshop to get feedback from the grade school students (“clients”) on their preliminary designs.

This workshop has the flexibility to be implemented in courses where large team projects are not part of the curriculum. In a systems design engineering course, this workshop ran as a stand-alone offering in which students brainstormed designs as part of an in-class activity. The activity began with the instructor giving the students a design problem to solve. First, the students individually brainstormed six to eight solution ideas. They were then instructed to choose their best solution and to present it on paper, using graphical methods and short written descriptors, in

order to convey their ideas without further explanation. This was necessary as students were not given an opportunity to pitch their ideas or answer questions until later in the activity. The students then reconvened as a team and used a heat mapping process to indicate parts of their teammates' designs that they liked, did not like, or had questions about, using different colored stickers. This heat-mapping process was anonymous and students were instructed not to discuss their thoughts with their teammates until the process was complete. Team members then critiqued each solution using the strategies outlined for interpretation, evaluation and recommendation. A particular challenge noted in this implementation was a sense that some student teams did not take the activity as seriously as other students did in the other implementations of this workshop, most likely because the design problem was not tied to a course project.

Results and Discussion

The degree to which this workshop contributed to student learning was evaluated in the workshop offered in the second-year mechanics course (enrollment = 140) As part of the course delivery, the students went through multiple rounds of feedback, including the workshop on giving and receiving feedback described in this paper. The students first met with the clients for the project (the local public school students), then submitted a preliminary report where they received feedback from the course teaching team. The students then went through the feedback workshop before meeting with their clients a final time. At the end of the term, a final design report was submitted for assessment.

Prior to the workshop, students were asked to take a survey that intended to evaluate students' challenges regarding giving and receiving feedback. The survey also intended to assess the degree to which the students knew about the strategies that can be employed to address those challenges. The survey included four multiple choice questions of the form, "*What are the top three considerations from the following options when giving positive feedback?*" The questions asked about giving and receiving both positive and constructive feedback. This pre-workshop survey was completed by 127 students. The results are presented in Table 1.

These questions were designed not only to help us to develop an understanding of the students' concerns, but also to help motivate students to pay more attention to the content of the workshop by prompting them to consider potential gaps in their knowledge. As Table 1 indicates, students generally were most concerned with maintaining a positive tone when giving feedback, and listening attentively when receiving feedback. As previously discussed, these criteria were covered in the workshop.

Table 1. Frequency of students' top three consideration when giving/receiving positive/constructive feedback; the top three responses in each category are in **bold**.

Multiple choice response	Giving feedback		Receiving feedback	
	Positive	Constructive	Positive	Constructive
Positive/friendly and non-threatening tone of voice	20%	12%	9%	9%
Open and welcoming body language	12%	6%	14%	11%
Using clarifying questions to improve understanding	5%	7%	14%	13%
Providing a balance of positive and constructive feedback	10%	14%	5%	4%
Providing many details in a direct, clear and specific manner	5%	7%	3%	4%
Offering practical and realistic suggestions	6%	11%	3%	3%
Focusing on actions and facts, rather than character traits	4%	7%	4%	4%
Focusing on future goals, rather than past actions/outcomes	4%	6%	5%	5%
Avoiding personal comments	6%	9%	4%	5%
Sharing suggestions or ideas, rather than giving advice or dictating change	4%	7%	3%	3%
Supporting ideas with facts	6%	5%	3%	2%
Listening attentively, rather than interrupting or appearing distracted	8%	3%	16%	13%
Remaining calm	2%	2%	9%	12%
Respecting differences in ideas and perspectives	8%	6%	8%	11%

Next, the students were asked to write about the challenges they usually face when giving feedback. A thematic analysis of the students' responses revealed that the students mostly struggled with the following criteria when thinking about giving feedback:

- Understanding the other side's perspective and how the message will be received from their point of view,
- Creating a positive, constructive, and respectful dialogue that shows empathy and understanding,
- Being clear and convincing in providing the feedback, and,
- Concerns about the quality of feedback

Similarly, students were asked to write about the challenges they usually face when receiving feedback. A thematic analysis of the results identified the following general categories of challenges that they face when receiving feedback:

- Not taking the feedback personally and understanding that feedback is given to improve their work,
- Controlling their emotions (anger, anxiety, sadness, etc.),
- Not being sure about how to respond to different types of feedback, and,
- Asking the right questions to understand feedback

After the workshop, students were asked to answer the second survey that intended to assess: i) the degree to which students understood and could remember the basic concepts taught in the workshop, ii) the students' affective evaluation of what they have learned (i.e., whether they had found value in what they were taught), and iii) how the workshop delivery was perceived. The survey also sought student input on how the workshop contents and delivery might be improved in the future. The post-workshop survey was completed by 106 students.

The first part of the survey included a few multiple-choice questions designed to evaluate students' understanding and remembering of the material. More than 80% of the students answered these quiz-like questions correctly. The affective evaluation questions were modeled following Bloom's Taxonomy of Learning [8], [9]. Table 2 displays the questions and the degree to which students agreed/disagreed with the statements. Generally, the results show that between 75% and 85% of the students found value in what they had learned in the workshop. Almost 90% of the respondents stated that they enjoyed the workshop. The main areas for improvement identified were i) more time to practice giving/receiving feedback, and, ii) a few students expressed a wish that the content was more advanced since they were already familiar with some of it.

Students also had a final opportunity to reflect on the impact of the workshop at the end of the project. As part of their final report, teams were asked to answer six questions to capture their thoughts on the feedback workshop:

- 1) What was the impact of the feedback workshop on your team's final design?
- 2) Was the feedback workshop helpful for your team's feedback/design process? How?
- 3) Was continuing to include feedback in your teamwork throughout the project helpful? Why or why not?
- 4) What is one feedback area/skill you developed as a result of the feedback workshop? What is one you wish to improve further?

- 5) Describe where the skills you learned in the feedback workshop were used to provide feedback successfully in the project.
- 6) Was the feedback workshop useful in gathering feedback during your second client consultation?

Table 2. Frequency of student responses to the post-survey evaluation.

Question	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I think what I have learned in this module will help me to improve how I give and receive feedback in the future	30%	54%	10%	2%	4%
I would like to learn more and practice more about how to give and receive feedback	28%	44%	19%	6%	3%
I will utilize what I have learned in this module (about giving and receiving feedback) in my future professional experiences	38%	49%	8%	3%	2%
I personally think that a proper interpretation, evaluation, and a proper format in which we frame our recommendations are essential steps for delivering constructive feedback	47%	41%	7%	4%	1%
I already have some ideas/strategies in mind about how to give and receive feedback more effectively in my future teamwork/professional experiences	32%	53%	10%	4%	<1%

In the following, we present a thematic analysis of those reflection pieces. Of the 39 groups in the class, 27 provided feedback of between 100 and 800 words. These responses were analyzed to detect any patterns in their responses. Ultimately 19 codes in four broad categories (affect, skill, project improvement, workshop feedback) were used to describe their responses. The codes are summarized with their frequencies in Table 3.

Responses coded in the affect category related to a change in how the students felt regarding their efforts on the course project after participating in the workshop. For example, one group commented “*The workshop also created positive feedback and validation towards multiple elements in our structure, including some that our team was still hesitating on including*”.

Table 3. Summary of reflective feedback for mechanics course workshop implementation.

Code	Category	Freq.
Project Improvement	Project improvement	21
Skill development	Skill development	21
Found the workshop useful	Workshop feedback	20
Applied the workshop to client meeting	Workshop feedback	19
Applied the workshop to some aspect of project process	Workshop feedback	14
Change in perspective	Skill development	12
Improvement made re: Safety	Project improvement	9
Communication	Skill development	7
Improvement made re: Accessibility	Project improvement	6
Improvement made after peer comparison	Project improvement	6
Self-reflection	Skill development	5
Team dynamics	Skill development	5
Heat mapping	Skill development	4
Correction made to project	Project improvement	3
Encouragement/validation	Affect	3
Improvement made re: Inclusivity	Project improvement	3
Increase in confidence	Affect	2
Increase in creativity	Skill development	1
Positive workshop atmosphere	Workshop feedback	1

Responses coded in the skill development category spoke specifically to an improvement in students' skills relating to giving or receiving feedback: “[*The workshop*] provided us with the skills to be more open to other’s perspective and opinions in an enthusiastic and supporting way”. Responses coded in the project improvement category commented on improvements made to their design due to the feedback they received from peers, or from seeing the solutions

their peers came up with: “*During the feedback workshop, there were many ideas exchanged between groups... This exchange allowed for a different perspective from the other groups... The design was then modified after the discussions*”. The final category was for comments that provided feedback (whether positive, or negative) on the workshop itself: “*The feedback workshop had a huge impact on the team’s final design ... It improved the final layout exponentially*”..

The majority of groups agreed that the workshop was useful, and validated that view by describing how the skills they learned were used throughout the rest of the project (either within their team, or in the second client meeting). The peer reviews that occurred during the workshop typically provided students with a subset of the following three project changes:

- 1) Corrections to either address safety, accessibility, or inclusivity concerns,
- 2) New ideas by comparing their design with the work of other groups, and,
- 3) Improvements by forcing the original group to see the project from a different perspective

A small number of groups commented that the workshop provided positive affective impacts on the team or team members. This took the form of encouragement and/or validation of their design decisions, with two groups specifically commenting about increased confidence as they progressed through the rest of the project.

From a skill development perspective, most groups provided examples of skills where the group excels and also where improvement is needed. Most of these skills were ones taken directly from the workshop, like paying attention to body language, or active listening, however several other skills were brought up as well. Those most commonly mentioned included communication, especially interpersonal communication; the heat mapping technique used in the workshop (which was used a few times in the second client meetings to mixed effect – who knew that little kids like applying a lot of stickers to things?); and skills relating to teamwork and team dynamics. While no one mentioned it specifically, there was evidence in a number of student responses that they were actively self-reflecting and correcting their behavior with their peers and with the clients. Lastly, one group specifically mentioned an increase in creativity after consulting with their peers in the workshop: “*The feedback that was not possible to do actually created even more discussion within our group and attempting to solve the problem forced [the group] to get more creative with the design. Without the feedback workshop and the second client consultation, [the group] would’ve never added the chime panel or the sign language learning panels which ended up being key components of the design*”.

Conclusions

This paper has described the development and implementation of a feedback workshop as part of a series of teamwork-focused workshops. The workshop was designed to be implemented with an existing team project and to allow flexibility in terms of its purpose, so that it can be adapted to suit the intentions of the instructor. In all cases, students were able to reflect on their learning experience by answering survey questions and/or reflecting on the value of this workshop in their design reports. In general, students responded very positively to this learning experience, with each round of student feedback providing greater insight into how the workshop could be modified to ensure that students recognize the value of the feedback process as a professional skill and that they become comfortable giving and receiving feedback to each other.

Acknowledgements

The authors would like to acknowledge the IDEAS Clinic at University of Waterloo (UW), the Center for Teaching Excellence (CTE) at UW and the Student Success Office at UW for funding and supporting the development of these workshops.

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