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A Peer Assessment System to Improve Student Team Experiences

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Groups are frequently used in courses, but there is substantial evidence that insufficient attention is paid to creating conditions for successful teamwork. One key condition is high-quality, individual, and team-level feedback. An online peer assessment system and team improvement process was developed for this test case based on three design criteria: efficient administration of the assessment, promotion of quality feedback, and fostering effective team processes. Sample data from 13 teams were collected to propose a means of testing the system against these criteria.

Keywords: collaboration, feedback, peer evaluation, team

At the sixth annual Teaching Professor conference, three undergraduates were invited to talk about their student experiences. They made a plea to the college instructors assembled, “no more group assignments—at least not until you figure out how to fairly grade each student’s individual contributions” (Glenn, 2009, para. 1).

Across most disciplines, faculty make frequent use of student groups to create engaging learning environments, develop collaboration skills, and meet employer needs for people who can work effectively in teams. While the goal is to provide a positive learning experience, the reality often falls short (Pieterse & Thompson, 2006). Oakley, Hanna, Kuzmyn, and Felder (2007) reported that 68% of engineering students worked in teams, and one quarter were dissatisfied while Bolton (1999) found 72% of business students reported working in teams, with one third dissatisfied. In both cases the principal culprit was the presence of shirkers or slackers, reported in one third of undergraduate classes, and one fifth of graduate classes (Oakley et al., 2007).

Peer assessment is widely used by instructors to discourage social loafing, assign individual grades, and help students learn from others’ observations of their behavior. In general there are two types of peer assessment approaches: summative and formative. Summative assessment typically occurs after the team endeavor to determine grades. Formative as-

essment is conducted during the class or project to provide feedback for improving the teamwork processes or products. Both approaches are frequently used.

Oakley, Felder, Brent, and Elhadj (2004) emphasized interim formative assessments. Gueldenzoph and May (2002) reviewed the peer assessment literature for best practices and found that nongraded, formative assessments are the most effective means to help the team surface and resolve problems. Bacon, Stewart, and Silver (1999) cautioned against using end-of-term, summative peer assessments because they may actually expand team differences. Members may tolerate undesirable behaviors instead of confronting them, “thinking that they can ‘burn’ those they are in conflict with at the end of the quarter on the peer assessments” (Bacon et al., 1999, p. 474).

Brutus and Donia (2010) noted that most research has focused on peer assessment effects within evaluated groups. Their study examined students who did team projects in two consecutive semester courses; some completed peer assessments both semesters, while others did so only in the final semester. They found that student performance in the repeat assessment groups was significantly higher than for students who were only evaluated once. Their study raised the potential that peer assessment feedback could help students develop team skills and that positive effects of peer assessment feedback may be enhanced through repeated use and greater emphasis in the pedagogical process.

Unfortunately, as Cheng and Warren (2000) countered, effective peer assessment can be time consuming to administer with traditional methods. Administrative time is a

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disincentive to the willingness of faculty to conduct repeated formative assessments with which students may actually improve their collaboration skills. To combat this, logistics need to be addressed. Our test case research will describe a researcher-developed system to collect and process peer assessment data. The hosted web-system is available to the larger education community. This research also suggests a pedagogical process for conducting the formative peer assessments designed to enhance team development. Sample data are collected in an exploratory manner to indicate how future research could validate its efficacy.

STUDY

Our long-term goal, in which this study is a first major step (Ferrance, 2000), was to enable students to become more effective team members. Toward this end, we developed a web-based system for capturing and reporting student team peer assessment feedback. The system was designed to accomplish three principle objectives: (a) administer the feedback process efficiently, (b) promote quality feedback, and (c) foster effective team processes.

The first objective, efficiency in collecting, compiling, and reporting peer assessments, is necessary for instructors to consider engaging in the peer assessment process. Paper-based feedback methods have various disadvantages: instructor effort and time to transcribe or summarize comments (a requirement to maintain anonymity), as well as delays in returning results to students. The instructor effort is a disincentive to frequent formative feedback rounds. The result is longer delays between behavior and feedback, or use of summative feedback only, which is more punitive than behavior-changing. Students are only able to improve if they receive the feedback in a timely manner as a formative tool for improving behaviors.

The second and third objectives, quality feedback and effective team processes, are based on the expectation that individuals will be much more willing to change their behaviors within the team when provided constructive information about what to change. If the system can promote quality feedback and foster more effective team processes in the short term, students will be more likely to learn to become more effective at working in teams over the long term. Handwritten comments present two anonymity issues that may affect feedback quality: (a) the receiver is more likely to interpret the feedback in light of his perceptions of the author and (b) the author is likely to reduce his candor regarding certain behaviors.

Sample data were collected from two courses taught by one author (R. A.) in information technology management. Both involved upper-division undergraduate students working in four to five person teams on extended, multi-phase projects. One was a senior project capstone course in which student teams worked on real client projects across

the semester. The five teams had full responsibility for their work and client relationship while designing and developing an information system. The second course was in systems analysis and design. Seven teams worked together through a 13-week project delivered in four phases. The course and project addressed gathering, analyzing, and prototyping requirements for a new information system.

Historically, teams have been an important aspect of both courses. Usually the teams work well together, but, anecdotally, there are often some broken teams bringing their problems to the instructor. Slackers are the most common symptom, but the circumstances differ wildly. The core problem appears to be remarkably consistent, involving some blockage in group communications. A behavior (or lack of it) is observed by other team members, then problems snowball as assumptions fill in the cause or motivation, and members withdraw or exclude other members from key conversations, meetings, or assignments.

Our question was the following: Will improving the feedback communications between students affect the incidence of broken teams? If members regularly gave feedback to one another in a constructive, problem-solving atmosphere, could we reduce the incidence of miscommunications turning molehills into mountains? If we instituted a process in which student team members had a safe and legitimized space for sharing and discussing feedback, could we overcome the tendency of students, as peers, to avoid giving constructive feedback to one another?

TEAM IMPROVEMENT SYSTEM

The feedback process was administered by a system consisting of software and processes. Figure 1 illustrates the broad outlines of the team improvement process (TIP) designed for use with the system. After the initial class setup, the instructor may conduct as many formative or summative assessment cycles through the TIP as he wishes with a minimum of extra administrative effort. The system components are described below for each step of the process.

The peer assessment system (PAS) was designed to conduct summative and formative peer assessments of student team behaviors. One author (R. A.) tested and refined the prototype for two years before he and a colleague developed the current, fully hosted, online system.

Initial Course Setup

Three setup steps were required for the course. The first step was forming teams. The instructor assigned teams using criteria of common meeting time blocks and diverse skills and interests. Second, in one course, an hour of initial team training was provided (a prerequisite to senior project). Students read "Coping with Hitchhikers and Couch Potatoes on Teams" by Oakley (2003) and related their past experiences

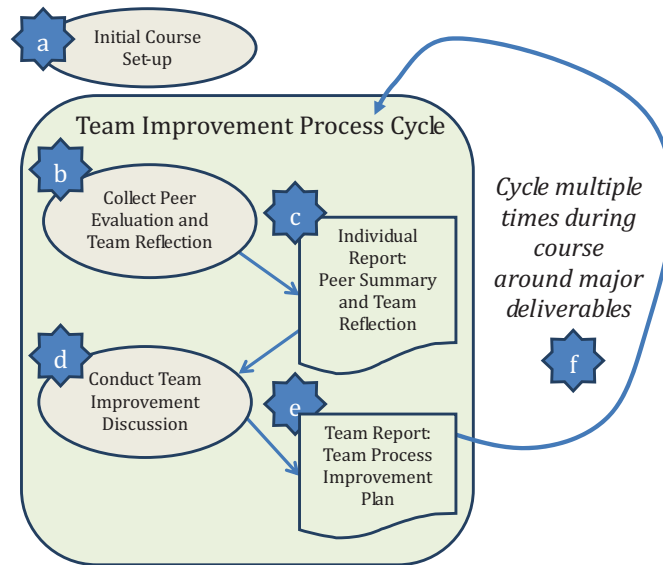


FIGURE 1 Team improvement process (TIP) for gathering and disseminating team behavior feedback (color figure available online).

back to the case in a short essay. This was followed by an in-class discussion about team problems and best practices. Then teams developed a team charter—an extended form of the expectations agreement used by Oakley et al. (2004)—for their first project milestone.

The third step was to load the student information into PAS from a simple Excel file with student names, email addresses, and team names. Finally, three assessments were set up for the classes. Each assessment was defined by a start, end, and two reminder dates so that PAS could send preformatted email messages to students with links to take their survey or access their personalized report.

Peer and Team Reflection Survey

Each TIP cycle started by emailing the invitation message and link to each student to complete the assessment outside of class. Many of the questions were adapted from Oakley et al. (2004). See Appendix A for an abbreviated form of the questions. The four question sets included closed and open-ended peer assessment questions repeated for each team member (and the respondent—as a self-reflection) then a set of closed and open-ended questions regarding the team.

Individual Report: Peer Summary and Team Reflection

When the assessment ends, PAS emails the students a link to view their personalized feedback report. Closed responses are summarized and open-ended responses are listed anonymously. Appendix A illustrates a sample student report that includes (a) averaged ratings on nine questions about his or her team citizenship behaviors, (b) suggestions supplied to student by team members (anonymous), (c) averaged rat-

ings on eight questions about overall team functioning, and (d) responses to three open-ended questions about the team (anonymous).

The comprehensive instructor report is similar to the student report except that it identifies the author of ratings and comments to enable the instructor to explore potential biases and inappropriate comments. The instructor report also displays results for a holistic rating question to calculate grades for individual team participation.

Conduct Team Improvement Discussion

In formative assessment rounds for this study, based on the TIP, the instructor printed student reports to hand out in class with a few minutes to silently read. Then teams met for a focused, 10–15-min team improvement discussion. To guide the discussion, a common post-review technique was used: (a) What are we doing well? (b) What are we doing poorly? (c) What are the top three things we should do differently? This approach is both simple, easily adopted, and reinforced a common real-world approach.

Team Process Improvement Plan

Each team member was asked to take meeting notes during the improvement discussion. These notes were transcribed into the team's process improvement plan for their next phase of work.

TIP Assessment Cycles

Three assessment cycles were conducted in each course, following each major project milestone. These included two formative peer assessments, at approximately the one-third and two-thirds points in the class, plus a final summative round in

which the TIP cycle ended after step (b). In the senior project course, team participation was qualitatively factored into the individual's final grade. In the analysis and design course, students were awarded individualized project participation points (up to 10% of the project total.) These individual team points were calculated using an approach adapted from the Cheng and Martin (2000) study that adjusted individual student participation by the team's rating norms: (individual score / average individual score for team) \times (.10 \times possible project points). The individual score question, using a 9-point scale, reads "For {Team Member}, please rate his/her level of participation, effort and sense of responsibility, not his or her academic ability. This evaluation is confidential and will not be shared with your team members," and was evaluated with the following scale anchors: 1 = excellent; 2 = very good; 3 = satisfactory; 4 = ordinary; 5 = marginal; 6 = deficient; 7 = unsatisfactory; 8 = superficial; 9 = no show.

SAMPLE DATA AND MEASUREMENTS

Sample data were collected to illustrate possible assessments of each design goal—(a) efficient administration, (b) quality feedback, and (c) effective processes. These data are presented here to suggest how a more rigorous study, using a larger sample and control groups, could reliably evaluate the efficacy of the PAS as a whole, and in terms of particular features.

Efficiently Administer the Feedback Process

Administrative efficiency could be evaluated by recording the average time for the instructor and students to complete each step of the assessment process. Table 1 shows the average times in the sample data for the preliminary setup, as well as for the instructor and student activities related to each step in the TIP. These times are averaged across the two courses and the three assessment iterations for each course. Shaded cells represent in-class activities.

Overall, the instructor spent an average of 15 min at the start of the semester to set up each course and customize emails in the web survey software. This did not include time required to create a spreadsheet with the student names, emails and team names to upload, nor time to assign students to teams. Then each cycle required about 25 min of instructor and 25 min of student time. In total, only 25 min of class time were required per cycle to hold team improvement discussions. The system, however, allows students to access their feedback reports online. If in-class team discussions were not held, each cycle would require only 10 min of instructor and student time (step b), plus time spent reviewing feedback.

Promote Quality Feedback

Feedback quality could be measured by evaluating the student-peer comments against criteria denoting feedback

TABLE 1
Average Times for Instructor and Student to Complete
Each Activity of the Team Improvement Process

TIP step	Instructor time	Cycle time per student
(a) Initial course setup <i>Prior to first cycle for a given class</i>	15 min <i>Set up course and customize messages (create student spreadsheet, assigning teams, and training time is not included)</i>	N/A
(b) Collect peer assessment and team reflection survey	10 min <i>Create distribution and reminder using saved panel and messages</i>	10 min <i>Open and respond to survey over internet messages</i>
(c) Produce individual reports	5 min <i>Print individual reports; download instructor report</i>	NA
(d) Conduct team improvement discussion	5 min <i>Handout individual reports plus TIP planning form; start team discussions</i>	15 min <i>Discussion and recording</i>
(e) Produce team process improvement plans)	5 min <i>Copy Team Improvement Plans on copy machine</i>	NA
Total	One time setup: 15 min Per cycle: 25 min	Per cycle: 25 min

Note. TIP = Team Improvement Process.

quality. Extensive literature exists regarding feedback characteristics that are more likely to produce behavior change to close a performance gap. DeNisi and Kluger (2000) conducted a meta-analysis of the feedback effectiveness literature to examine how to improve feedback interventions in general, and 360° appraisals in particular. Among their findings, they recommended feedback interventions that focused on the task performance and not on the person, include specific suggestions for improvement, do not compare individuals' performance to others, and deliver feedback by computer instead of in person.

Another feedback characteristic that has received attention is the positive or negative orientation of the feedback. DeNisi and Kluger (2000), among others, pointed out the complex effects of feedback orientation on performance. While Lizzio, Wilson, Gilchrist, and Gallois (2003) found that using positive feedback could help mitigate adverse effects of negative (i.e., corrective) feedback on self-esteem in management situations, studies of students have found positive comments were often discounted (Hyland & Hyland, 2001) or that positive feedback may soften critical comments

TABLE 2
Characteristics Used to Code Comments for Feedback Quality

Coding characteristic	Coding values (high quality)	Description
Focus	Task focused, personal focused, both task and personal, neutral	Comment describes the peer's task performance behavior versus a personal characteristic
Orientation	Positive, negative, mixed, neutral	Comment provides an affirmative and/or unfavorable description of the peer's participation
Specificity	Constructive, general	Comment includes specific suggestions for improvement or specific reinforcements versus general statement

to the point where the feedback loses its impact on behavior change (Young, 2000).

We suggest evaluating feedback quality using the three criteria shown in Table 2: task focus, directive, and orientation. Values relating to high-quality feedback are also identified in the table.

A total of 134 comments were submitted to the question "make at least one to two constructive suggestions for [team member name] to improve his or her team participation and contribution." Of the 160 promptings, 131 (82%) received comments. The authors independently coded each comment by task focused, constructive, and orientation with a composite interrater reliability of 94%, indicating that the codes were consistently interpreted.

Our experience is that students often find it difficult, as peers, to provide directive comments to one another that seek to guide effective behavior. However, as shown in Table 3, over two-thirds of the comments (69%) were directive. The majority of comments (61%) focused on process while only 16% focused on tasks. Nearly half (47%) of the comments were positive while 37% were negative (indicating a need for change).

Mixed-orientation comments comprised only 14% of the total. We would like to have seen more of these which are often believed to be the most effective due to the positive effect they might generate to propel behavior changes. The only other sizable set of comments was positive, nondirectional comments. These evoke a general sense of support but lack sufficient specificity to aid individual improvement.

To provide a sense of the types of comments students provided to one another, Table 4 provides some examples of comments. The codes for orientation and direction are included.

TABLE 3
Orientation and Directive Nature of Relevant Peer Comments Input by Students

Item	Directionality or directive		Total % (n)
	Constructive/specific	general/nonspecific	
Orientation			
Positive	18	29	47 (60)
Negative	36	0	37 (47)
Mixed	14	0	15 (19)
Neutral	0	0	0 (1)
Percent (n)	69 (87)	32 (40)	100 (127)
Focus			
Process	54	6	61 (77)
Task	12	4	16 (20)
Process and task	3	0	4 (5)
Neither	0	20	20 (25)
Percent (n)	69 (88)	31 (39)	100 (127)

Note. Totals may equal more than 100% due to rounding.

Foster Effective Team Processes

To evaluate team process effectiveness, questions included within the Peer Assessment were available. Each student was asked how his team used eight important team processes. Each team process was rated on a 4-point Likert-type scale ranging from 1 (*never*) to 5 (*always*). The results in Table 5 show the average scores across all eight questions by class. See full questions in Appendix A, question B1.

Three team processes stood out as strengths for most teams: assigning tasks to all members, focusing criticism on ideas instead of on people, and the team's ability to assess itself. The latter two points may have been related to the TIP used in these classes. One item stood out as a weakness,

TABLE 4
Sample Student Peer Assessment Comments

Codes	Sample comments
Negative directive	"More frequent communication with team members will be really helpful." "Try to listen to team members[sic] ideas, it is hard for you to consider others' opinions."
Mixed directive	"Karl, you were amazing this semester. My suggestion is try to let your teammates take more responsibility. It's tough when their work isn't at the same standard as yours, but everyone learns from contributing." "Even though Michael is easily distracted he still worked hard through the semester"
Positive directive	"Betty is a great teammate and has a sharp eye. She constantly looks at situations from a different perspective and asks questions to make sure we have everything covered." "Julia offered so much talent to our group. Thanks for your hard work, and helping teach the group some new things."
Positive nondirective	"Sheila is the very definition of a model student/employee" "Thanks Sheila!!"

TABLE 5
Average Rating for Each Team Process by Class

Question	Analysis and design class	Senior project class	Overall
1. Team buys in to agreements	3.1	3.3	3.1
2. All members are assigned tasks	4.2	4.2	3.9
3. Team stays focused	3.4	3.9	3.6
4. Criticizes ideas, not people	4.2	3.9	4.1
5. Team works with a clear plan	3.4	3.6	3.5
6. All members contribute work	3.4	3.7	3.5
7. Team can assess itself to work more effectively	4.2	3.9	4.1
8. Completes work before last-minute deadlines	2.7	3.1	2.9
Overall	3.6	3.7	3.6

Note. Ratings were defined on a 5-point Likert-type scale ranging from 1 (*never*) to 5 (*always*).

“completes work before last minute deadlines.” This was consistent with the instructor’s informal observations that student teams were extremely deadline-driven.

One final point should be raised about the findings in Table 5. The literature suggests that the presence of a slacker appears to be the single greatest cause of team problems. Question 6, “All members contribute work” provides a means of comparing the findings in this study with others. Analyzed on the team level, only two of 13 teams (15%) had an average score below 3.0. On the individual level, only 11 of 54 students, about 20%, rated a team member as a 1 (*never*) or a 2 (*rarely*) on this measure. In comparison, Oakley et al. (2007) reported that 29% of all engineering students taking classes over a two-year period reported at least one slacker among their course teams.

DISCUSSION

Formative feedback, focused on team behaviors, can be a potent ingredient for improving student teamwork (Guelden-zoph & May, 2002; Kaufman & Felder, 2000; Oakley et al., 2004). However, the question of efficiency raised by Cheng and Warren (2000), is an important practical issue to overcome. Conducting formative assessments, especially multiple rounds during the life of a student team, can consume extensive instructor time and effort. Can use of a computer system improve the efficiency of administering formative peer assessments and improve the quality of feedback and the changes in team behavior? This study illustrates the design and use of a computerized peer assessment system and

describes the collection of sample data that, in a larger study, could provide conclusive support for this question.

Four design decisions for PAS were intended to positively influence the quality of feedback and impact on team behaviors. First, anonymity was intended to enable the receiver to focus on the content of the feedback, rather than the source. Second, increasing assessment efficiency was proposed to encourage instructors to make more frequent opportunities for teams and members to reflect on and improve their behaviors. Third, open-ended questions concerning the individual and team were intended to engage the student in constructive reflection of their own, their peers’, and their team’s behaviors. Finally, the team improvement discussion immediately following the feedback report was planned to redirect individual attention toward taking positive, practical changes as a team. Further research will be needed to isolate these effects.

This study is missing three important factors that need to be added in future research. This study lacked control groups without peer assessment, or which employed alternative assessment methods, to determine the extent of difference made by the PAS intervention. Similarly, there were too few teams to examine the relative strength of various influences. Lastly, some degree of longitudinal assessment is needed for both individuals and teams. It must be possible to determine whether any immediate, observed effects on students or teams constitute longer term learning and change.

Relatively few changes to the system are required. Principle among the changes is adding the ability to compare assessment results over time to track individual or team progress. This information could help the individual identify persistent behavioral weaknesses on which to focus his or her change efforts, or assist efforts to coach or instruct students in how to improve his or her team skills. If the system could track a student’s assessments across different teams and different course topics or types of interactive environments, the assessment information could have even greater impact (McGourty et al., 2001).

Two process changes should be tested, based on suggestions from Kaufman and Felder (2000). First, they recommended adding a preliminary practice assessment cycle, using a case, for students to gain familiarity with the assessment. A similar approach could be used for students to see how the PAS application works, to understand the questions asked, and to view the anonymous report format. The second change is to apply guidance in brief, just-in-time crisis clinics at key team development stages. The insight gained by an instructor into the challenges shared across teams could enable a targeted approach to such interventions.

CONCLUSION

Oakley et al. (2007) summed up their report with the following: “Students are not born knowing how to work effectively in teams, and if a flawed or poorly implemented

team-based instructional model is used, dysfunctional teams and conflicts among team members can lead to an unsatisfactory experience for instructors and students alike” (p. 270). Bacon et al. (1999) wrote, “Students learn more about teams from good team experiences than from bad ones” (p. 485). A key best practice for fostering positive student team experiences is to provide individual students and teams with timely and repeated high-quality feedback (Johnson, Johnson, & Smith, 1991). Without feedback, students will not be able to learn to improve their behaviors—this time, or the next time around.

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APPENDIX A: Student Report

Jeffrey [redacted]
Team "B"

IDM320-AM (Rob Anson) - Individual Assessment #4

Individual Assessment

For Jeffrey [redacted], comment on specific areas they can improve and areas they are doing very well. Please make your comments constructive and helpful. (These suggestions will be shared with the team member.)

- Self: Needs to take a larger share of the work and needs to be more active at meetings.
- I would like to see Jeff step forward a little more when working with the team. Jeff is a good voice of reason when our group is experiencing any kind of conflict or confusion.
- Spend more time preparing before meetings
- It felt like communication was lacking again but improved as the milestone went along. Good job on this milestone.
- It's good to see you're making it to meetings again.

Question (1 - Never; 3 - Sometimes; 5 - Always)	Self	Peer-Only Average
Attends team meetings?	4	3.5
Communicates and responds promptly with teammates?	5	4.0
Meets team deadlines to complete assigned work?	5	3.8
Takes the initiative to help resolve conflicts in the team when needed?	3	3.8
Voluntarily takes on his/her share of work assignments?	4	3.8
Expresses ideas and opinions clearly?	4	4.0
Listens and respectfully considers teammates' ideas and opinions?	5	4.3
Helps other team members when they need it?	5	3.8
Steps up to help the team plan, coordinate and track its work to meet team goals?	4	3.8

Team "B" Assessment

Considering how your team works together, what things does your team do particularly well?

- We did well at sharing the work load.
- gets work done by deadline
- Coordinating workloads
- I think we have done a very good job of rallying late in the milestones in order to ensure that everything is done on time. Also, the team's review comments make the revision process much easier
- We've got the process down, we review, update, and communicate as needed.

All teams experience some difficulties. What particular challenges has your team recently faced?

- Other class work loads are heavy. Not meeting our deadline, and finishing at the last minute.
- Keeping all members on task
- Absenteeism, conflict regarding definitions of key terms
- I think the big problem we faced this milestone was not going through exactly what was required in this milestone. We got so focused on the UCD and our individual cases and completely missed those non-functional requirements.
- There were a lot of meetings with at least one person missing, which made it harder to stay on the same page and move forward as a team.

Considering how your team works together, what things does your team need to improve?

- Holding the team members accountable according to the team charter.
- Keeping focused
- Improve meeting attendance

- As always we should be emphasizing the need to stay on top of communicating with the group with problems arise. Also, we might want to go through the requirements of the milestone as a group to ensure that we don't miss something on the next milestone.
- The betwe en time management and meeting attendance, though neither is really bad at the moment.

Question (1 - Never; 3 - Sometimes; 5 - Always)	Average Rating
My team members help one another as needed.	4.2
My team members really listen to each other when exchanging ideas.	4.2
My team effectively resolves disagreements.	4.0
My team stays focused.	4.0
My team plans and tracks the work that needs to be done.	4.2
All team members tend to share in the team's work.	4.4
My team actively discusses how it works to try to improve its processes.	4.0
My team does not wait until the deadline to complete its work.	3.8

INDIVIDUAL ASSESSMENT

For [student] comment on specific areas they can improve and areas they are doing very well. Please make your comments constructive

INDIVIDUAL ASSESSMENT

Team Citizenship Behavior ratings.
Average of Peer Ratings
Compared to Self-Rating

TEAM ASSESSMENT

What things does your team do particularly well?

What particular challenges has your team recently faced?

TEAM ASSESSMENT

Team characteristic ratings