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Cultural Influence on Providing Peer Feedback in an Engineering Design Course*

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This study evaluates cultural differences between students based in Austria (n = 20) and the United States (n = 6) around providing fast, frequent team feedback evaluation during an engineering product development course. Both cohorts consist of self-selected teams working on project topics and products of their own choosing. Students were required to provide feedback on the performance of their teammates by indicating if their work was complete and on time for each assignment and through the ordinal ranking of the contributions of each team member to the individual assignment submission over five assignments and after the final project. The perceptions of the students are recorded following the final feedback submission of the course to understand how effective they perceived the feedback tool, including the authenticity of their participation, noted behavioral change in themselves and others, opportunities to increase the impact of the feedback information, and the overall effectiveness of the feedback process. Significant differences were noted in the approach and attitude of students to team member issues that might inform instructors attempting to gather information on teams and increase awareness of cultural differences to the approach to feedback preferred by students.

Keywords: project-based learning; peer feedback; team member evaluation; team feedback

1. Introduction

Engineering design courses often include artifact creation in degrees ranging from no or low-resolution prototypes to minimum viable products to fully functional prototypes in service to the design education process. Rarely are the prototypes themselves the ultimate objective of such courses as they are vehicles to explore, prospectively or retrospectively, decisions made in service to the creation of an artifact for a user or customer. Reflections on design decisions will inform future design work, including the challenge of transforming concept to physical artifact, as well as the prioritization and tradeoffs associated with the creation of the concept. In a sense, reflections on the experience of avoidable errors in the physical realization of a design are intended to be the generalizable educational outcome that will help better inform future designs.

For students working on teams in engineering design courses, many factors contribute to the creation of engineering design knowledge through the experience. One critical aspect of making in an educational context is the creation of a team which is mutually accountable to the teams' work product and to each other. When considering making in design, educators may tend to prioritize creation of physical artifacts and processes over creation of environment and culture. Tools, materials, and physical space are critical for artifact creation. But, alone, they are insufficient for a scalable and generalizable designing and making educational experience. Building of teams is an important part of this experience. This may be especially true for students lacking previous teamwork skills, experience, and team interaction. Students are sometimes exposed to an archaic and frustrating sink-or-swim teaming approach or to a description of team development stages without other meaningful oversight, guidance, or recourse. Few design instructors would encourage a student to explore a makerspace or to use a machine tool and hope they will figure it out without appropriate instruction and supervision. Nor would instructors intentionally cultivate a makerspace environment hostile to newcomers or one that prevents students from learning new techniques. If such issues are suspected or identified, great effort will be made to address them.

Leaving the significant issue of safety aside, it is expected that making skills are cultivated in a learning focused, supportive atmosphere. Yet many times students are expected to independently determine how to function on student project teams with insufficient or unclear guidance. This may be compounded by a lack of instructor ability to monitor team member interactions, which might be equally discouraging as an unwelcoming machine shop or maker space. Teams are sometimes monitored with informal check-ins (often, with all team members present) and/or with an invitation to raise team issues requiring help to the instructor. Such options for recourse may be of limited effectiveness, particularly if students feel that admitting team issues is indicative of individual or team failure or that calling the attention of the

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instructor to team issues will damage team cohesion. This may be especially true with respect to informing instructors of problems privately. A goal of team making may include creating a team culture of accountability and making issues transparent. The ability to raise concerns helps ensure inclusion of all team members and that the team experience is a positive learning experience for all students.

Students will experience team performance setbacks and insights parallel to those of the building and making experience. These will better inform future team making decisions through the benefit of reflection. Unlike making physical artifacts, the making of a team can involve decisions that are intensely emotional and that have complex social implications for team members beyond the classroom. It is in the interest of students and instructors to address these issues early and to provide tools to manage conflict productively rather than attempt to ignore or suppress it. Course correction is easier with early intervention.

Engineering professors must balance intervening in student work to help them solve problems while permitting a reasonable degree of struggle with the concepts so that students may learn independently. This balance is particularly challenging when teaching a team about teamwork. Intervening too early deprives students of the learning experience of addressing issues, which will be critical for future teamwork. Intervening too late may permit issues to escalate beyond correction. To help students address team issues, instructors must first be made aware a problem exists. Hesitancy to notify an instructor, sometimes for fear of making the problem worse, can delay intervention, sometimes past the point of usefulness. This can happen when team members cover for another's lack of productivity in the hopes that the individual will eventually reciprocate but fails to do so. It can also happen when seemingly small issues appear and compound, such a team member as being slightly late for a team meeting, then missing significant meeting time, and finally skipping meetings.

Attempting to gain insight into team activities can be challenging for instructors as much of the work happens outside of their direct observation and much of the evaluation happens in a setting inconducive to raising issues about team member performance. One way to develop insight is to require a confidential evaluation in the affirmative that team members are contributing equivalently. Conducted with sufficient frequency, this can serve as a record of when issues first arise. This benefits the instructor, student team, and team members by raising the issue so that it may be addressed. It may also provide a fairer record of an individual student than an end of term evaluation which might erroneously claim that a specific team member never did anything. While gaining early and frequent insight is valuable, it can also be perceived as invasive or even malicious, depending on the culture of the team.

Teams are influenced not only by the team members assigned to them but also their cultural standards and institutional expectations. Some cultures prefer direct, clear discussions of any performance or technical issues while others might regard this approach as aggressive, ungraceful, self-serving, or simply rude. It is also possible that the same feedback from different people may be interpreted differently, particularly with respect to perceptions of gender roles and expectations [1]. The opacity of team innerworkings to instructors will encourage some teams to proactively address issues but might encourage others to avoid them. Understanding how culture contributes to feedback and to preferences for intervention is important for instructors to manage team observation and intervention methods. On teams with members of different cultural backgrounds, the differences in expectations may take longer to normalize than might be typical for teams with a common cultural reference or expectations or may prove ostracizing for team members with different or minority cultural perspectives.

This study seeks to identify cultural differences in how students on a project-based team perceive a team member feedback process that requires brief but frequent team evaluations which are shared with the course instructor throughout a project. The specific cultures in this study are those of the United States and Austria, however, the information may be generalizable to instructors teaching in any culture or teaching a team of students with different cultural perspectives. Instructors scaffold the degree of insight and intervention on student teams such that independence is developed but the teams are supported when required. Information on determining how to do this appropriately has been largely independent of the culture of the teams and of cultural differences of the individual team members. This may be particularly challenging for instructors teaching teams of students including those with international backgrounds who may struggle to understand the unwritten cultural rules of team member behavior. A default perspective might be that the visiting student must simply adapt to the local culture. This may be counterproductive to team performance. It may be that the cultural differences between team members extend to different training backgrounds and other factors not specifically investigated in this study.

Instructors have an obligation to guide students in teams working on project-based learning projects

in their courses with respect to teamwork. To do so, instructors need to know how and when to gather feedback from student teams so they can respond appropriately to student needs. To address this, instructors may consider what to measure, how frequently to measure, and whom to ask, but may not completely consider the impact of culture in the responses to such inquiries and the perception of the intent of inquiring about team interaction. This study seeks to understand the extent to which culture may influence the student response to requested team member feedback for a specific method of interest (frequent, brief evaluations).

2. Background

The impact of culture, cross-cultural cooperation [2], and team member behavior has been examined with respect to business activities and associated social norms in the international business literature [3]. The impact of culture in communication and decision-making during meetings, processes related to engineering design, are also explored [4]. The degree to which social norms and culture contribute to team feedback is less well understood. It is widely accepted that behavior acceptable in one cultural context is impermissible in another [5]. The distinctions about appropriateness of an action or communication may be confusing to those not raised in a specific culture. To be clear, this is not only that certain actions or statements are unacceptable to cultures but that some actions are unacceptable within certain contexts and acceptable in other contexts.

The same feedback expressed in the same way in Japan and German cultures could lead to very different results and interpretations. German business culture tends to or attempts to separate a concept from the individual espousing the concept [6]. This encourages objective assessment of an idea separately from the person who offered it. In addition to the desired state of objectivity, the German business culture tends to or attempts to encourage open confrontation about differences of opinion in a business setting. In contrast, the business culture of Japan tends to or attempts to link a concept with the individual offering it. This makes it difficult to criticize an idea without also criticizing the individual offering the idea. This does not mean that ideas are never criticized or that one only criticizes ideas of those colleagues they dislike, but rather that the method and context of criticism and discussion is changed. Note that there is not an inherently correct way to regard ideas as far as association with a person offering an idea. These and other approaches work well within their cultural contexts.

This study investigates a simple, fast feedback online tool that can be used quickly to check on the performance of team members. Online feedback tools in design reviews have been shown to be effective for peer learning [7] and teaching [8, 9] and are effective for students with diverse thinking styles [10]. Peer feedback, including anonymized feedback [11], has been shown to be effective in improving student learning for both those providing and receiving the feedback [12]. This study investigates cultural perceptions and differences about teams and team member feedback between students at a program in the United States and students at a program in Austria. The study investigates and compares the use of this fast team performance feedback tool with students in a product development course at Management Center Innsbruck, a European University in Innsbruck Austria (n = 20, spring term of 2020), and students in a product development course at Harvey Mudd College, a United States small liberal arts college in Claremont, California, United States (n = 6, fall term of 2020). The goal of this research was to determine if student teams benefit from a fast, simple tool to provide timely feedback on individual team member performance to the course instructor either through its use or through its presence. That is, is a benefit to team performance achieved through the delivery of actual feedback on team members which might be addressed by instructor intervention or through the knowledge that the tool might be used by them or their team members to provide such feedback.

In academic settings, design reviews are frequently address the design process and execution of the process by the team, which is intended to simulate the industrial experience. However, lack of candor and concern for reciprocal criticism may limit authentic peer feedback [13]. It is easy in academic design reviews to overlook impediments to a full review [14]. The process of providing and receiving feedback can be complicated by issues of reciprocal review, particularly when not anonymized, [15] and may lead to self-censorship by reviewers or rejection of the feedback [16]. Similar to review of artifacts, review of team members may be limited in an effort to protect the team cohesion or the individual members. Such reactions may be stronger when focused on individual behavior instead of an artifact or design process decisions. This may lead to a desire to defend individual actions rather than receive suggestions for improvement [17] and may limit the information shared with instructors regarding workload distribution or other contributions.

The timing of this study coincided with the 2020 coronavirus (COVID-19) global pandemic that

resulted in both courses being taught entirely online and without access to campus facilities such as makerspaces, machine shops, tools, or computers with dedicated modeling or other software. In all cases, student teams were working together remotely using online meeting tools. For some teams, the student team members were in different countries. Though individual students in both courses identified culturally across a range of groups, the study considers the primary culture to be that of the home institution for each course, which is predominantly representative of the cohorts. The study attempted to measure the impact of the coronavirus pandemic on the use of the fast feedback tool by asking specific questions about changes in honesty of their responses and the overall challenge of teamwork during the pandemic and its resulting social distancing/isolation requirements. Nevertheless, the response to the coronavirus pandemic rapidly changed over the course of the year and the perception of its impact likely changed as well. The required social distancing added this as a factor to the experiment that could not be controlled for with a comparable group of students working together in person.

3. Study

Students in both the Austrian and United States based cohorts were grouped into teams through self-selection to work on topics of mutual interest to the team members. Both the team members and general project topics were known to the students when they selected their teams. The projects consisted of four phases (need discovery, problem definition, solution development, and business considerations). At each phase, teams were required to submit a status report. In addition, teams produced a final report summarizing all work and reflecting on specific decisions. Concurrent with submission of reports on each phase and the final report, students were required to complete a brief team member evaluation that characterized the quality of each team member's contribution (including their own contribution) to the project as acceptable and on time (or not) and to ordinally rank order the contributions of each team member for that project phase. As with feedback in a design review, the goal is for reviewers to identify opportunities and strengths of the artifact and process [18] that result in actionable information [19, 20] for the improvement of the artifact or process [21], including individual design process participation. Choosing a written feedback mode reflects the ease of interaction but also the generally superior nature of written feedback in design reviews [22]. In addition, written feedback has been previously demonstrated to increase comment quantity [23], which increases opportunity for improvement and reinforcement of observed strengths [24]. This tool was conducted using an online Formstack survey. The goal of this tool was to provide students with a required means to alert the instructor to any team performance issues. This information was believed to be particularly important in the absence of face-to-face meetings with teams outside of the online lecture or meetings requested by the teams resulting from the coronavirus pandemic but was believed to be useful in general [25]. The resulting feedback information was not shared directly with students, though the instructor responded immediately to any answer of "no" with respect to satisfactory contributions of a team member reported by any student.

Following completion of the course, students evaluated the team evaluation tool itself and their experience with its use by completing an online survey. Unless otherwise noted, the survey used a 5-point Likert scale (1. Strongly Agree, 2. Agree, 3. Neutral, 4. Disagree, 5. Strongly Disagree) covering 17 questions. In addition, students could respond to five open ended questions. The question prompts are focused on specific aspects of the team experience, which likely plays a role in the specific feedback provided [26]. The survey was conducted in English, which may pose issues for non-native speakers [27]. Students were also able to voluntarily enter demographic information, including the culture with which they most closely identified. Data from this survey is presented, including responses to individual background with teamwork, degree of honesty in evaluation of team members and themselves, change in behavior resulting from the online tool use, perspective on teamwork during the pandemic, and perspective on the usefulness of this method of providing feedback on team members. Student responses were collected across six topical areas, prior team experience, honesty in feedback, behavior changes in response to evaluation, challenges around teamwork during the coronavirus pandemic, potential evaluation transparency influence on changing behavior, and effectiveness of this feedback process. Differences between responses of the cohorts are explored in the context of culture of feedback and team behavior.

4. Hypotheses

To determine if there are differences in responses between the groups of students which might be attributable to cultural differences in team behavior and feedback to team members, several null hypotheses were generated which presume no difference between groups will exist. Each hypothesis

was tested using questions from the survey to determine if it can be rejected based on statistically significant differences in the responses of the Austria based and United States based cohorts.

Tested Hypotheses:

There is no difference in the:

1. Self-reported honesty of comments offered between Austria and United States based students.
2. Concern about peer evaluations between Austria and United States based students.
3. Behavior change from using the feedback system between Austria and United States based students.
4. Desire to see the team's ranking about oneself between Austria and United States based students.
5. Predicted behavior change from making comments public between Austria and United States based students.
6. Impact of coronavirus on teamwork between Austria and United States based students.
7. Perceived utility of the feedback process between Austria and United States based students.

The order of questions included in the survey is not the order of hypothesis statement examined. Questions used to quantitatively test the hypotheses evaluate different aspects of student perceptions and experiences. Some hypotheses were interrogated with more questions than others. The responses across these dimensions are evaluated for statistical significance with respect to each hypothesis. The questions related to each hypothesis are listed in Table 1.

5. Coronavirus Pandemic

The hypotheses were evaluated by comparing responses to questions based on the category of interest. Hypothesis six was added in response to the coronavirus pandemic which necessarily modified team interaction for students at both programs in a way that was not anticipated when the study was initially conceived. While it is not possible to fully understand the direct impact of the pandemic on students within this study, an attempt was made to understand differences in the impacts directly focused on team activities and collaborative work. Nevertheless, differences in institutional and individual responses to the pandemic may play a role in ways that the researchers were unable to fully evaluate and may influence the ability to independently test the initial six hypotheses. It is also noted that the courses did not occur during the same term and the response within institution varied significantly with time as faculty and students found

Table 1. This table shows the questions used to test the hypotheses in this study. Not that the number of questions changes between the hypothesis tested and the order of the questions is not coincident with the hypothesis order

Hypothesis statement: There is no difference in the:	Related Question
1. Self-reported honesty of comments offered between Austria and United States based students.	Q4: I was always honest in my evaluation of team members in the online feedback for this course.
	Q5: I was always honest in my evaluation of myself in the online feedback for this course.
	Q7: I was overly generous in my evaluation of my team members compared to myself in the online feedback for this course.
	Q8: I was overly critical in my evaluation of my team members compared to myself in the online feedback for this course.
2. Concern about peer evaluations between Austria and United States based students.	Q6: I was concerned how team members might evaluate me in the online feedback for this course.
3. Behavior change from using the feedback system between Austria and United States based students.	Q9: I changed my behavior because of the required online feedback for this course.
	Q10: I saw a change in the behavior of team members because of the required online feedback for this course.
4. Desire to see the team's ranking about oneself between Austria and United States based students.	Q13: I would like to see my team ranking from my team members from the online feedback for this course.
5. Predicted behavior change from making comments public between Austria and United States based students.	Q14: If team member ranks were publicly reported for each feedback opportunity, I would change my own behavior.
	Q15: If team member ranks were publicly reported for each feedback opportunity, I believe team members would change their behavior.
6. Impact of coronavirus on teamwork between Austria and United States based students.	Q11: I was more honest in my team member expectations and feedback discussions for the time we were in social isolation due to the coronavirus.
	Q12: It was harder to work on a team due to social isolation form the coronavirus pandemic.
7. Perceived utility of the feedback process between Austria and United States based students.	Q16: I had a sufficient number of opportunities to provide online feedback for my team members in this course. Q17: The feedback process was helpful.

better ways to address the crisis through improved online methods or connections but also became increasingly fatigued with the situation.

With this in mind, it is not possible to correct for the influence of the pandemic induced test conditions through repetition of the experiment. The influence of the pandemic on teams and teamwork may be of interest to engineering educators in the broader context of exclusively or primarily online teams. As an example, schools seeking to partner with distant industrial or other project sponsors or with external academic programs may benefit from the information generated here with respect to team interaction.

6. Data

The data collected in the course ending survey of students about their use of the fast feedback system is presented in this section. The topics covered by the question sections include teamwork background, honesty in answering questions, behavior change, concerns related to coronavirus, response transparency and changes in behavior, and evaluation of the feedback method with respect to frequency and helpfulness.

6.1 Statistical Treatment

The nature of this study includes multiple comparisons for two study groups. The resulting concern of Type I errors, or incorrect rejection of a null hypothesis, is managed in this data using the Benjamini-Hochberg method which controls for False Discovery Rate and results in a reduced likelihood of false negatives or Type II error compared to some other methods [28]. The value of Q (false discovery rate) chosen for this analysis is 0.10, which is on the conservative side of the acceptable range for managing the likelihood of Type I errors while reducing Type II errors, or false acceptance of the null hypothesis [29]. When statistical significance is referenced with respect to data, it is with respect to the correction produced using this method. All P-values presented are the unmodified values from a Student's T-test assuming two tails and homoscedastic distributions of data for the groups tested. Use of the parametric Student's T-test for incremental data is one of several acceptable techniques for analysis of Likert scale data as there is little difference between this method and the Mann-Wiley-Wilcoxon non-parametric treatment of similar data and sample sizes [30].

6.2 Background and Prior Experience

Each student was asked to describe their prior experience on teams, their experience with team members completing tasks, and their response to difficulties encountered.

Question 1. Have you ever worked as part of a team for a course prior to this one? Scale: Never, Once, Many times

One hundred percent of Austrian students and eighty-three percent of United States students reported working on teams "Many times". Seventeen percent of US students reported never having worked on teams previously. The difference between these groups is not statistically significant ($P = 0.3632$).

Question 2. Have you ever had issues with team members completing their work on any team (not just this course)? Scale: Never, Once, Many times

Fifty-five percent of Austrian students and sixty-seven percent of United States students reported issues with team members completing their work at least once while twenty percent of Austrian students and fifty percent of United States students reported issues with team members completing their work many times. The difference between these groups is not statistically significant ($P = 0.3732$).

Open Ended Question 1. Primary issues involving team members included. . . The options shown in Fig. 1 were listed as choices within the question while the topic "Other" permitted additional information to be entered which may be seen in Appendix A.

Question 3. If you experienced issues with team members in any course (not just this one), did you address it with them? Options: Yes or No

Sixty-four percent of Austrian students and forty percent of United States students experiencing team issues reported addressing the issue with the team member involved. There was no statistical difference it the response to this question ($P = 0.4384$).

Open Ended Question 2. If you addressed issues with a team member, what did you do? If you did not, why not?

All Austrian students who reported addressing an issue indicated that they spoke directly to the team member. The United States students indicted calling a team meeting or threatening to involve the instructor in the issue. Of the Austrian students who did not address the issue, 57 percent said the issue was not sufficiently significant to address, 29 percent said it was easier to do the work than to get the teammate to do it, 14 percent said they were concerned about upsetting team morale and 14 percent said that they would speak directly to the teammate (though they indicated they did not in this case). Of the two United States students who did not address the issue, one said they completed the work themselves and one indicated an issue of safety that had to be addressed through instructor intervention.

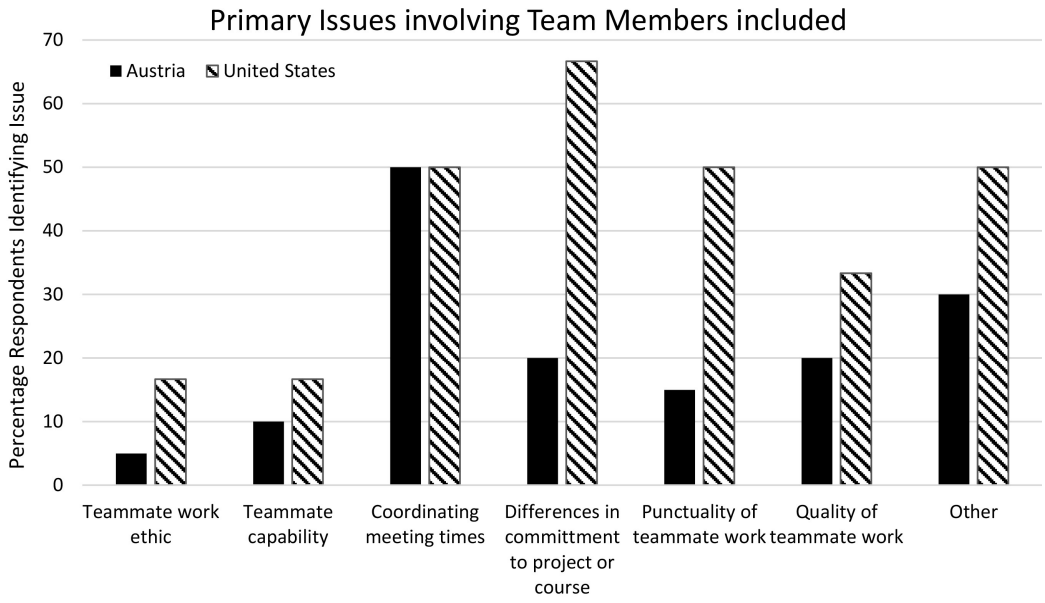

Fig. 1. Percentage of students indicating areas of prior concern with team members for the regions studied. Overall, there appears to be a higher incidence of prior negative teammate experience in United States based students compared to their Austrian counterparts in all areas other than coordnation of meeting times.

There was no statistical difference in the background of students with respect to prior experience working on teams, experiencing issues with team members, or the likelihood of addressing team issues. However, the majority of AU students experiencing team issues were likely to report talking directly to the team member involved, and none reported raising the issues to an instructor, while a significant fraction of US students experiencing issues were likely to report it to an instructor.

6.3 Honesty in Reporting and Concern for Perception

Students were asked to describe in retrospect how accurate they were in reporting, how critical or generous they were in evaluation of themselves with respect to their team members, and how concerned they were about the evaluation they received from their team members.

The questions on these topics are listed below. The data from the study is shown in Fig. 2. The vertical scale is shown for a range of responses on a five-point Likert scale (1. Strongly Agree, 2. Agree, 3. Neutral, 4. Disagree, 5. Strongly Disagree). Responses shown are averaged. The vertical axis has been extended to a range of 0 to 6 to accommodate error bars, which indicate 95% confidence intervals. This format is common to Figs. 2–6.

Question 4. I was always honest in my evaluation of team members in the online feedback for this course.

Question 5. I was always honest in my evaluation of myself in the online feedback for this course.

Question 6. I was concerned how team members might evaluate me in the online feedback for this course.

Question 7. I was overly generous in my evaluation of my team members compared to myself in the online feedback for this course.

Question 8. I was overly critical in my evaluation of my team members compared to myself in the online feedback for this course.

As seen in Fig. 2, United States based students were statistically more likely than Austria based students to agree that their responses to the team evaluation tool were honest with respect to both evaluation of team members (Question 4: AU: 2.40, US: 1.33, P-value: 0.016) and their own contributions to the project (Question 5: AU: 2.25, US: 1.33, P-value: 0.026).

There was no statistical difference between the Austria and United States based groups in reported concern with respect to the feedback provided of them by their team members (Question 6: AU: 4.05, US: 3.17, P-value: 0.2813).

There was no statistical difference between the groups in reporting being generous in their evaluations of team members compared to themselves (Question 7: AU: 3.40, US: 3.66, P-value: 0.605). However, United States based students were statistically more likely to disagree that they were overly critical of their team members compared to themselves (Question 8: AU: 3.55, US: 4.66, P-value: 0.002).

6.4 Observed Behavior Changes

Students were asked about changes in their own behavior or changes in the observed behavior of

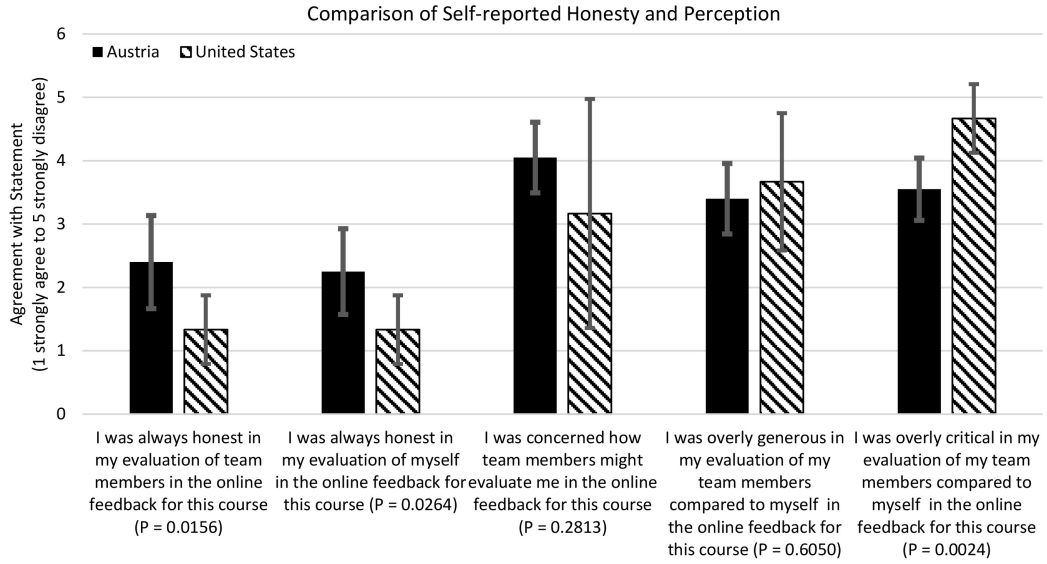

Fig. 2. The self-reported honesty in evaluation of self and team members, concern over the rating provided by others, and the degree to which evaluations of team members might have been adjusted are shown. Notably, the differences between United States and Austrian students are statistically significant for all questions other than generosity of teammate evaluation and concern about team member ratings.

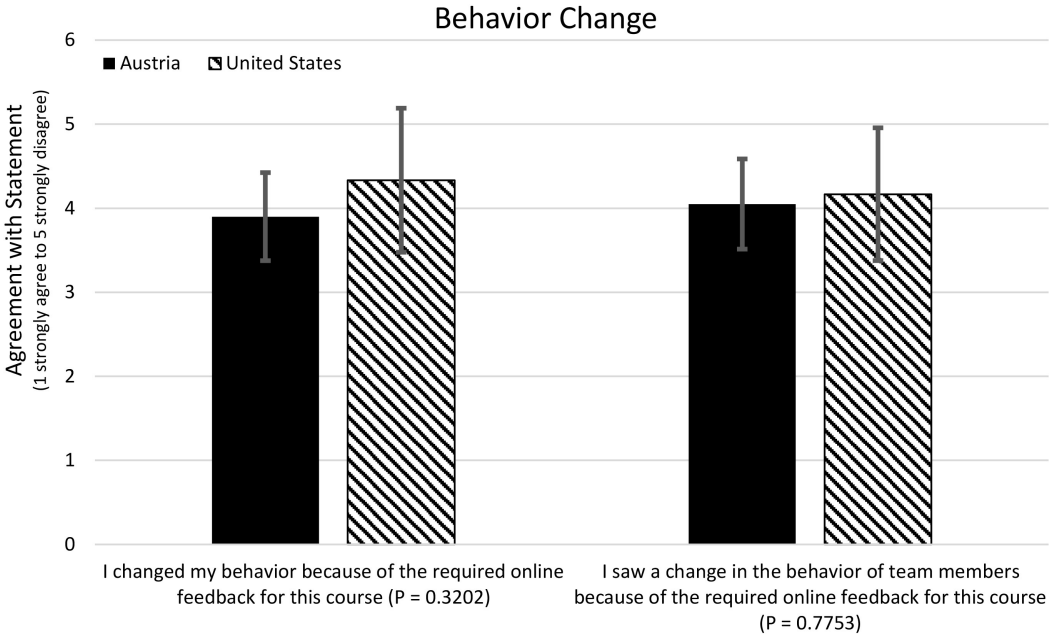

Fig. 3. There is no statistical difference between United States and Austria based students with respect to their own behavior change or behavior change observed in team members as a result of the evaluation process.

team members as a result of using this feedback tool. The specific questions on these topics are listed below. The data from the study is shown in Fig. 3.

Question 9. I changed my behavior because of the required online feedback for this course.

Question 10. I saw a change in the behavior of team members because of the required online feedback for this course.

Neither group was statistically more likely to report changes to their own behavior (Question 9: AU: 3.90, US: 4.33, P-value: 0.320) or observing changes in team member behavior due to use of the team evaluation tool (Question 10: AU: 4.05, US: 4.16, P-value: 0.775). However, some Austria based students reported changing their behavior or seeing changes in others because of the use of the team evaluation tool. There was a high correlation for both Austria (0.78) and United States (0.87) based students between observations of changes in their own behavior and observations of changes in other team member behavior.

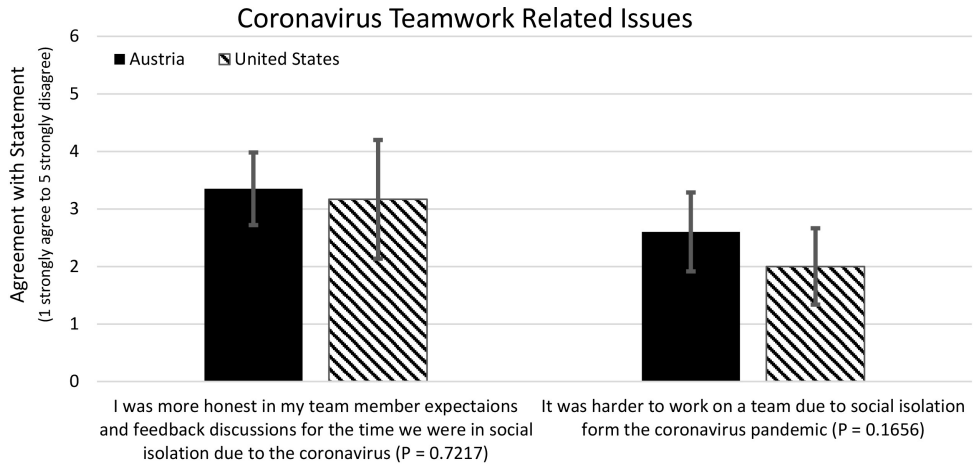

Fig. 4. Social isolation due to COVID did not impact evaluation honesty differently between Austria and United States based students. Difficulty with respect to teamwork during the coronavirus pandemic was not statistically different between Austria and United States based students.

6.5 COVID Issues

Students were asked about the impact of the coronavirus pandemic on their team evaluations and teamwork. The specific questions on these topics are listed below. The data from the study is shown in Fig. 4.

Question 11. I was more honest in my team member expectations and feedback discussions for the time we were in social isolation due to the coronavirus.

Question 12. It was harder to work on a team due to social isolation form the coronavirus pandemic.

Open Ended Question 3. Why do you feel it is harder or easier to work on a team due to social isolation from the coronavirus pandemic?

Of Austria based students indicating an increase in difficulty to work on teams due to COVID social isolation requirements, most attributed this to a lack of in person contact or requirements for more formal meeting scheduling and issues with online meeting software and internet connection. For Austria based students indicating reduction in difficulty, they primarily indicted the benefit of online meeting tools (which were familiar from prior use) and a reduction in travel time for meetings. For US based students indicting increased difficulty, lack of casual connection, internet connectivity, time zones conflicts, and online meeting fatigue were specific topics reported. Those indicating less difficulty cited the ease of setting up meetings without travel time requirements.

Fig. 4 reflects that both groups of students agreed that there was an increased difficulty in team projects due to COVID (Question 11: AU: 2.60, US: 2.00, P-value: 0.166) but did not report changes to their honesty in team interactions due to COVID (Question 12: AU: 3.35, US: 3.16, P-value: 0.722). There was no statistical difference between Austria and United States based students with respect to these responses.

6.6 Evaluation Transparency and predicted Behavior Change

Students were asked about their degree of interest in seeing the scores assigned to them by their team members and the expected impact of making the evaluation ratings transparent to team members on one's own behavior and team member behavior. The specific questions on these topics are listed below. The data from the study is shown in Fig. 5.

Question 13. I would like to see my team ranking from my team members from the online feedback for this course.

Question 14. If team member ranks were publicly reported for each feedback opportunity, I would change my own behavior.

Question 15. If team member ranks were publicly reported for each feedback opportunity, I believe team members would change their behavior.

Fig. 5 shows that United States based students were more likely to want to see their individual rankings compared to Austria based students (Question 13: AU: 3.35, US: 2.00, P-value: 0.010). However, both United States and Austria based students believed that making the ratings of team members public would have no difference on their own behavior (Question 14: AU: 3.30, US: 3.4, P-value: 0.659) or that of their team members (Question 15: AU: 3.15, US: 3.40, P-value: 0.428).

6.7 Frequency and Helpfulness of the Fast Feedback Process

Students were asked about their opportunities to provide feedback and the helpfulness of the fast

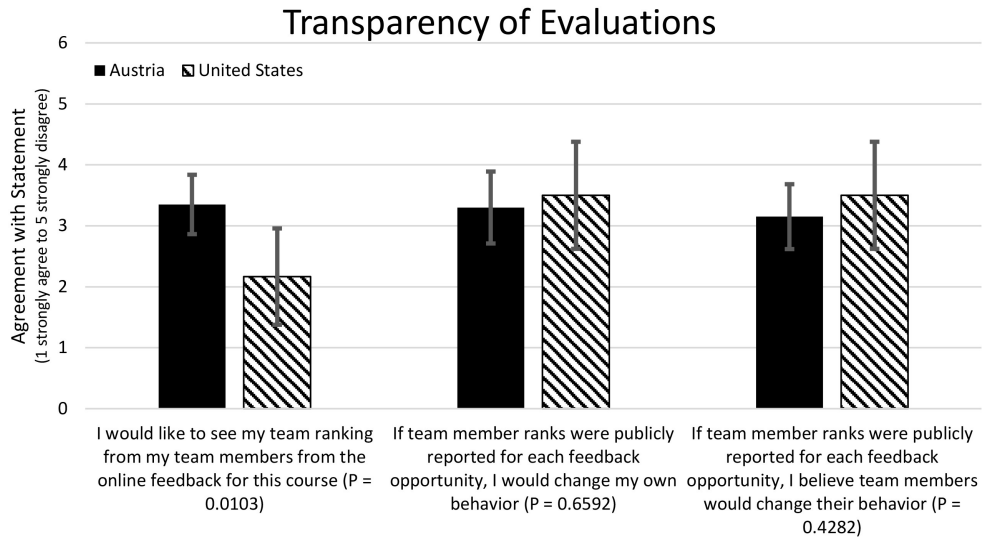

Fig. 5. Although there is no statistical difference between United States and Austria based students in terms of their expectation of behavior change for either themselves or their team members if evaluations of team members were public, the United States based students were statistically more likely to want to see their ratings from team members than Austria based students.

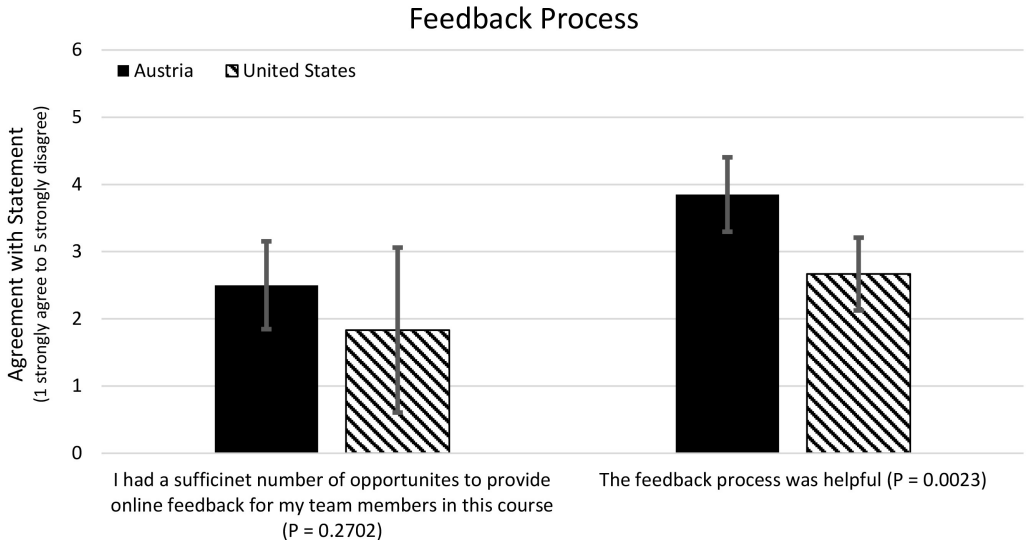

Fig. 6. There was no statistical difference between Austria and United States based students with respect to the number of opportunities to provide feedback but the United States based students were statistically significantly more likely to identify the feedback process as helpful.

feedback process for their project-based teams. The specific questions on these topics are listed below. The data from the study is shown in Fig. 6.

Question 16. I had a sufficient number of opportunities to provide online feedback for my team members in this course.

Open Ended Question 4. Comments on the number of feedback opportunities.

In general, the comments from Austria based students show a reluctance to comment on their peers and the United States based students were more comfortable commenting on peers. The comments on the frequency of evaluation collection ranged from the correct rate to higher frequency would be appreciated. The complete list of comments is included in Appendix A.

Question 17. The feedback process was helpful.

Open Ended Question 5. Comments on the feedback process.

In general, the comments from Austria based students again show a reluctance to rank peer performance indicating the team is capable of working through issues independently. The United States students were more comfortable sharing feedback but did not see a response to the feedback in the course which may have improved its utility. The complete list of comments is included in Appendix A.

Overall, the Austria and United States students perceived a sufficient number of opportunities to provide feedback on their team with no statistical difference between the groups (Question 16: AU: 2.50, US: 1.83, P-value: 0.2702). The United States based students were statistically more likely to find the feedback process to be helpful compared to Austria based students (Question 17: AU: 3.85, US: 2.67, P-value: 0.0023).

6.8 Qualitative Observations

Qualitative direct observations on team member performance are inherently difficult because the majority of team interaction happens outside of the observation of the instructor. During the coronavirus pandemic, social distancing made direct team behavior observations even less likely as many meetings transitioned to online from in-person. The generalized observations offered in this section are based on the open-ended responses to the survey questions and are categorized in terms of experience and preparation, response to team issues, desire for external monitoring of teams, and desire for external intervention in team member conflict.

Prior experience with teams was comparable between groups and students. In instances of team conflict, the majority of Austria based students advocated direct confrontation with team members while the United States based students appeared more willing to request instructor intervention. This appears consistent with comments that the feedback process appeared to me needlessly intrusive (and even potentially disruptive) to some Austria based students while it was more neutral to United States based students, some of whom indicated that the process might be more useful if it resulted in additional intervention. The Austria based students appeared more likely to complete tasks for underperforming team members rather than seek instructor intervention to ensure an even distribution of effort.

Factors contributing to these differences may include individual perception and tolerance of conflict, the degree to which academic programs attempt to assign individual grades or group grades on projects, and balancing the interpersonal and time cost of improving team function compared to the expected increase in value resulting from the improving performance of the underperforming team member. While all these factors may play a role, it is not entirely possible to separate these individual contributions from the dominant culture. As a result, it may be fair to say that the differences between groups in terms of their response to the feedback evaluation process are significantly attributable to the culture of teams rather than the support available.

7. Results

Student backgrounds were similar in terms of previously working with teams and reporting prior team issues. However, the self-reported incidence of underperformance of team members (teammate work ethic, capability, commitment, punctuality, work quality) are all directionally higher among United States based students compared to Austria based students. The challenge of coordination of team meeting times was similar for both groups. In terms of addressing issues, the Austrian students were more likely to directly address the issue with the team member while the United States students were more likely to involve the entire team or instructor to address the issue.

7.1 Accepted Hypotheses

Examination of the related quantitative questions does not support rejection of four of the hypotheses, numbers 2, 3, 5, and 7. Responses to the related questions do not show statistical difference between the groups on questions related to the four null hypotheses that there is no difference in the:

2. Concern about peer evaluations between Austria and United States based students.
3. Behavior change from using the feedback system between Austria and United States based students.
5. Predicted behavior change from making comments public between Austria and United States based students.
6. Impact of coronavirus on teamwork between Austria and United States based students.

7.2 Rejected Hypotheses

From the data, we can reject three null hypotheses, numbers 1, 4, and 6. Rejection of each is based on quantitative data from the set of questions related to the specific null hypothesis. Note that the phase "there is no difference" in each null hypothesis indicates that a difference between responses in any related question results in rejection of the relevant hypothesis.

7.2.1 Rejected Hypothesis 1

There is no difference in the self-reported honesty of comments offered between Austria and United States based students.

There are statistically significant differences in the responses to questions 4, 5 and 8 related to the general topic of honesty and criticality of team member evaluation. These differences indicate that the United States based students were more honest in the evaluation of their team members, the evaluation of themselves, and were not overly

critical of their team members compared to Austria based students.

7.2.2 Rejected Hypothesis 4

There is no difference in the desire to see the team's ranking about oneself between Austria and United States based students.

There is a statistically significant differences in the responses to question 13 on the desire to see one's own ranking feedback information from their team. United States based students are more likely to want to see the scores assigned them by their team members than Austria based students are.

7.2.3 Rejected Hypothesis 7

There is no difference in the perceived utility of the feedback process between Austria and United States based students.

There is a statistically significant difference in the responses to question 17 on the helpfulness of the feedback process. Austria based students were more likely to disagree that the feedback process was helpful than United States based students.

8. Interpretation

Many instructors have seen issues on teams that bring project work to a standstill. This may be regarded as a high intensity but infrequent event in team making. It is not possible to know if such events were absent in this study because of the ability to track feedback reducing the potential for free ridership or were simply not present for these cohorts. Given the low time cost goal of the team evaluation system, the potential benefit offered may be sufficient to justify its use in settings where monitoring of individual team member behavior is desired. However, the use of the specific technique applied in this study was found to be objectionable by some Austria based students, particularly by those who appeared comfortable directly addressing team issues. This may suggest that by the time instructors in Austria learn of team issues they have already been raised directly with the team members while this is not necessarily the case in the United States. This difference in approach might be better served with a different type of tool to track team member performance.

Both groups self-reported few changes in their own behavior or observed behavior of team members as a result of using this feedback tool. However, the two Austria based students reporting that the feedback process was helpful (Agree or Strongly Agree) were also the only students self-reporting a change in their own behavior (Agree) or report an observed change in behavior of others (Strongly Agree). Neither student reported prior issues with a team member in other projects. It is possible, that a subset of Austria based students benefited from the brief feedback even if it is globally not seen as helpful. This may be especially true for students without prior experience discussing issues with team members despite a culture in which such discussions are commonplace.

United States based students ranking the evaluation process as more helpful compared to Austria based students may reflect a greater cultural acceptance of addressing issues as a team or with the guidance of instructors rather than through direct confrontation with team members individually. The feedback system applied in this study may be seen as supporting such discussions or preventing their need through increased transparency, as United States based students were more likely to want to see their peer assigned scores than Austria based students.

The increase in perceived helpfulness of the feedback tool and in the desire to see one's own score may be inversely correlated with the degree of honesty in feedback provided. It may be that students providing more honest and fairer feedback are more inclined to want to see their scores and find the process helpful, as was the case in this study, independently of cultural differences. Similarly, the motivation to provide honest and fair feedback using the tool may be culturally linked so that cultures preferring less interference from an instructor in internal team issues also provide less honest feedback, thereby reducing the utility of the process.

Interpreting the student perceptions based on open ended question comments offers one possible explanation of the seemingly selective preference for using the feedback system. In this case it appears that there is a difference in the extent of prior experiences with team members between the groups (particularly with respect to commitment to a project), the manner of addressing issues (directly or as a group or with the aid of instructors), and the acceptability to raise issues to the attention of instructors. For United States based students raising issues involves contacting the instructor or involving the entire team while for Austria based students raising issues involves direct contact with the team member. This suggests a cultural difference of direct intervention with a team member as the more common mode of addressing issues in Austria based teams rather than a mode of group meetings or instructor involvement as it appears to be more typical in the United States. As such, a method to raise issues to the attention of the instructor fits better in the United States than in Austria. It is possible that in Austria, an improved system for providing feedback might permit better

direct contact with team members about performance, especially in the case of remote team activities. This might be why the Austrian responses to the feedback tool are less positive and, in some cases, even hostile.

It is unclear if either cultural perspective is superior for addressing team issues. It would appear that the teams who manage interpersonal feedback directly are more reluctant to seek or accept instructor intervention or even to accept monitoring. This might be different if the specific method of monitoring was less obtrusive. For example, if the system was a confirmation of acceptable team performance with no further details required unless an issue was raised, it might prove to be more acceptable in the cultural context of "fixing our issues on our own" but would permit issues to be raised promptly when necessary. This is a significant issue as teams focused on fixing their own issues are doing exactly what instructors would hope. They may legitimately be concerned that the instructor will impose a solution or penalty without a complete picture if provided additional insight to team innerworkings. Balancing the independence of the student learning experience of being on a team and holding the team mutually accountable with instructor intervention when required to help manage conflict is challenging. It would appear that this balance is significantly influenced by culture, which may be reflected in the comparative self-reported lack of honesty in the Austrian cohort that appears to have been less critical of team members based on questions 4, 5, and 8. As a result, the instructor is not necessarily better informed about team issues through use of such a tool as information may be withheld and is certainly less well informed than if the information was offered with greater candor. The issue faced is that through attempting to gain insight, the cultural norm may resist providing it if asked in such a way that is perceived to undermine team unity or autonomy.

Cultural differences, of course, do not end with national boarders and team members are not exclusively from individual regions. For example, the culture of medicine may differ significantly from that of engineering in manner of communication even within a common national culture. Appreciation of cultural differences on teams with respect to providing feedback can be especially important as teams and organizations globalize and diversify. Finding ways that recognize and address cultural expectations for providing feedback will require awareness of the differences in approaches to team issues and issue reporting.

Comparisons between groups of students, especially small groups, are necessarily challenging to generalize across institutions. This remains true despite statistically significant test results. The difficulty of generalizing cultures is increased by the introduction of uncontrollable variables, such as the relative impact of the global pandemic and the degree to which courses might be adjusted to accommodate them. Nevertheless, the data suggest that culture of addressing team issues has many similarities and some important distinctions within the groups studied. It is reasonable to believe that differences such as these or other differences with respect to feedback may be present when considering teams with different cultural expectations.

9. Future Work

The study conducted was considered too intrusive by Austrian student standards and insufficiently applied by United States student standards. This seeming contradiction might be addressed with a more flexible system that can tailor the information collected and the resulting response to the needs of students through an awareness of the cultural needs. We will consider changes to the fact feedback system that are generally less intrusive. An example might be not requiring ordinal performance ranking of members without a triggering alert that such information is needed. We will also consider ways to connect students through a direct alert that an issue exists rather than escalating to instructors. The question facing researchers for an improved system in Austria is, "Can the system be made to effectively track performance quickly without appearing needlessly invasive or disruptive?" One solution is to explore if the feedback system could become an invitation to celebrate extraordinary contributions or to teach team issue intervention. For United States based students a question facing researchers is, "How this might become a tool to encourage more direct initial interaction with team members to address issues independent of instructor involvement?" A potential solution might be to require direct interaction as a prerequisite to team or instructor involvement in issues. While it might seem that these goals are contradictory, it appears to be possible to create a single tool that can address issues in a way that is perceived as helpful by both groups in this study. Generalization of such a tool and its application in team-based courses and activities might also consider other types of cultural differences or teams without a single defined or dominant culture.

10. Conclusions

Cultural differences between students in Austria and the United States were found to play a sig-

nificant role in how feedback was provided about team members with respect to honesty of the feedback and the degree of candor in team member criticism. Overall, the feedback process was felt to be less helpful by Austria based students. This is somewhat unsurprising given that the students generally were not as forthcoming about team issues. This difference is increased somewhat by the inclination of Austria based students to directly address team member issues. For Austria based students without such prior experience, the fast feedback method was seen as more helpful. There were nevertheless comments suggesting that some issues were resolved by simply completing the underperforming team member's assigned work. This was also true for United States based students. However, the incidence of team member issues was typically higher for United States based students and they were more likely to involve the team or instructor in addressing these issues.

Specifically, engineering design educators seeking insight into project-based learning team member performance should consider the issue of team culture and how it will inform responses with respect to veracity and action. It may be possible to use the knowledge of team culture to tailor their questions to improve the feedback shared by students and to direct independent actions toward the goals of teaching students to make and build high functioning teams. Caution should be exercised with respect to the degree of insight sought as it may be perceived as assigning blame where none exists. Conversely, a lack of attention to team activities can invite issues observed with respect to underperformance or commitment that some teams may struggle to effectively address. Together, this suggests a method of independent evaluation that seeks details only when issues arise and guides the response to the team issues in the context of culture described through actions.

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Appendix A

Response to open ended Other category for Open Ended Question 1, Primary issues involving team members included.

The specific comments listed in the category "Other" in Fig. 1 follow without spelling or grammatical correction, as is the case for all comments presented in this paper. It is important to note that none of the students from Austria were not native English speakers and many put forth significant effort to understand and comment in English. Inclusion of raw comments is for accuracy:

Austria:

1. Other: We never had problems, because we worked together a lot already. Maybe minor problems, but nothing worth mentioning.
2. Other: no problems occurred.
3. Other: no problems at all.
4. Other: No Problems.
5. Other: of course the current situation is not allowing for face-to-face contact which makes some things really hard.
6. Other: None.

United States:

1. Other: NA.
2. Other: None.
3. Other: People just not wanting to do the work.

Comments on the number of feedback opportunities

Austrian students

1. The Saw Is The Law.
2. I don't like the feedback forms in general. Especially ranking the work everybody has done.
3. None.
4. None.
5. We did this during online meetings and via WhatsApp groups.
6. None.
7. We know each other and know how to work in a Team.

8. One cannot expect to do a groupwork and then rate somebody behind their back. Everybody should give what they can and it will always be that some people don't care, don't contribute. Being able to choose teammates you have worked with before helps as you know how the communication works and how much they will contribute.

United States students

1. Having a feedback opportunity after each Design Review was a good way to evaluate our teamwork in a consistent and timely manner.
2. I liked having the opportunity to give feedback after each Design Review.
3. My teammate commented on this to me, and I agree, that feedback would've been more useful or insightful for each component of the project we worked on. I think more practically this would be executed on a weekly basis.
4. I think that it was very fitting to have a feedback from with each design review.
5. If feedback was reported publicly I would be much more likely to lie and rank my team member higher and thus there would be even less opportunity for them to change their behavior. In addition, at that point the professor would not know how much work was being done by each person.

Comments on the feedback process

Austrian students

1. In my opinion Team member Rankings should never be reported publicly. There is no Need to pity someone, who just did not want to work on a Project, but sometimes People are just not capable of bringing more Input into a Project. I believe the most essential Thing you would get out of a Team member ranking is, if someone fits into a Team or if he/she does not.
2. None.
3. None.
4. We are not used to evaluating team members individually, there is something immature to it. The way we are used to do teamwork is: We get an assignment as a team and we deliver the result as a team, and anything else is to be discussed WITHIN the team.
5. "I did not like the ranking who was the best . . .
6. It would be enough if we could hit a button (late) for the person who did their work not satisfying".
7. We work together in a team and we knew each other before and therefore knew our skills and behavior. In my eyes it shouldn't be a need to challenge ourselves with such a feedback system, especially the system provided always places somebody on the very end of the scale. We take such challenges kind of in a military sense: We stand together and we fall together. We know what we have to deliver and accomplish this tasks as a unity.
8. The process of the feedback was very bad because we know each other for one and a half year know and worked together in many projects. So the group harmony was very good already. With the feedback we thought that we throw someone randomly under the bus if we rank them bad. We were all participating at the same extend and everybody has done his best. We thought that it is unfair if someone gets a bad grade when all of the work is done together and it is also bad for the team if someone gets a bad feedback, but nobody talks to him about it. The feedback system kinda destroys a good group harmony in my opinion.
9. "I don't like this way of giving feedback about my colleagues behaviour.
10. I think it is not fair to rank the work of my mades form best to worst!
11. "
12. In general, the feedback process is not very common in Austria and I don't think it was necessary at all! Why did we have to do it? What was the purpose of it? We are all adult students and if something does not go well or one student does not finish his work on time than we just tell him and that's it! I don't know what kind of methods are used in the US but these feedback forms are very unorthodox and not very helpful at all. I think the main purpose of the feedback process was to stir up trouble between us which is not helpful at all during these times!

United States students

1. Nothing was really done with the feedback in class or during team meetings and so it kind of felt a little extraneous but it is still good practice.
2. It was simple and straightforward.

3. I think [partner name] and I had a really good rapport and we worked really well together so the feedback process seemed pretty arbitrary.
4. I wasn't extremely motivated to reflect and break down all my experiences with my partner. The form wasn't very provoking or it wasn't taken seriously enough.
5. My partner and I worked really well together and we made it known to each other, so I suppose the feedback form was not really necessary.

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