ASSESSMENT OF INDIVIDUAL AND TEAMWORK ATTRIBUTES IN UNDERGRADUATE ENGINEERING STUDENTS

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Abstract – Engineers Canada Accreditation Board lists 12 Canadian Engineering Graduate Attributes necessary for program accreditation. One of these is the Individual and Team Work attribute. At the University of Calgary an annual survey has been developed to assess student perceptions of teamwork. The survey examines students’ overall satisfaction with teamwork activities, attitudes towards teamwork, perceived emphasis and support received from the department, teamwork skills (competence and importance), and personal support for teamwork initiatives. Based on the responses from past years two trends can be identified: students perceive a gap between their competence in teamwork skills and the importance of those skills, and students show high levels of support for more teamwork initiatives. Following these trends three recommendations can be made: teamwork skills development activities for the students, more opportunities for peer feedback in team projects, and support for first year students. By annually administering assessments engineering departments can evaluate their success in developing the necessary Individual and Team Work attribute required by Engineers Canada Accreditation Board for program accreditation.

Keywords: teamwork, peer feedback, accreditation, soft skills assessment, soft skills development, individual attributes

1. INTRODUCTION

Individual and Team Work is one of 12 Canadian Engineering Graduate Attributes identified by the Engineers Canada Accreditation Board (ECAB) as necessary for program accreditation [1]. For the past few years the Individual and Team Performance (ITP) Lab from University of Calgary’s Department of Psychology has partnered with the Schulich School of Engineering (SSE) to administer a survey assessing the Individual and Team Work attribute in undergraduate engineering students.

Assessment tools can be utilized to examine student competencies in the 12 attributes required by ECAB for accreditation of engineering programs [1]. The work that the ITP Lab does with the SSE assesses undergraduate students’ ability to work independently and as a member of a team. This assessment addresses the Individual and Team Work attribute that ECAB requires for accreditation [1].

Teamwork is a soft skill which can be difficult to formally analyse and develop [4]. The current world is highly team-focused [3] making it essential that postsecondary engineering students are graduating with the necessary teamwork skills to excel in their career. Through the assessment of the Individual and Team Work attribute engineering programs can ensure they are producing highly competitive graduates by identifying gaps in students’ skills and implementing changes to minimize/eliminate these gaps.

Students’ acquisition of teamwork skills can be assessed using scientific methods. In their work with the SSE the ITP Lab utilizes a survey design containing both quantitative and qualitative questions. Results from the survey are subsequently analysed to identify levels of teamwork competencies among the undergraduate students.

Two key trends in student individual and teamwork skills emerged from the results in work with the SSE over the past two years. First, there was a gap identified between the competence students perceived they had in teamwork skills and the level of importance they believed those skills to have in their future careers. Second, results indicated a high level of support for more teamwork initiatives such as: more teamwork skills training, more peer feedback opportunities, individual grading in team projects, and moderate support for more team projects.

Given these trends three recommendations follow. First, providing students with teamwork skills development activities. Second, providing students with opportunities for peer feedback in team projects. Lastly, providing support for first year students.
2. STUDY DESIGN

2.1. Sample

The ITP Lab conducts an annual survey of all undergraduate students enrolled in the SSE to analyze the Individual and Team Work attribute. This survey gets sent out to each student at which point they can choose whether they wish to participate or not. The survey has been conducted the past two years and has yielded over 1000 student responses (731 usable responses in 2016 and 683 usable responses in 2017).

The survey yields responses from males (58.9% in 2017; 61.3% in 2016, females (40.6% in 2017; 38.3% in 2016), and those choosing not to identify with a gender (0.5% in 2017; 0.4% in 2016). Responses come from individuals in varying points in their undergraduate education, ranging from first year and upwards of sixth year, as well as those individuals that are completing an internship. Figure 1 illustrates the distribution of the respondents’ year of study.

![Program Year Percentage Distribution](image)

Fig. 1. 2017 Program Year Percentage Distribution

All programs offered by SSE (common first year, geomatics, civil, mechanical, software, chemical, electrical, energy, and oil & gas) are represented, as shown in Table 1. Students also indicated an estimated number of teams they had been in during their time at the SSE. This ranged widely with an average of 6.13 (SD = 5.46) in 2016 and 7.16 (SD = 6.16) in 2017.

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<tr>
<th>Table 1: 2017 Program Distribution</th>
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<tr>
<td>Frequency</td>
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2.2. Survey

The survey addressed some key factors of student experiences of teamwork. This included overall satisfaction with teamwork activities, attitude towards teamwork, perceived emphasis and support received from the SSE, teamwork skills (competence and importance), and personal support for teamwork initiatives.

Attitudes towards teams includes psychological collectivism, team project satisfaction, and teamwork attitudes. Psychological collectivism is comprised of preference for group work, reliance on groups, concern for group, acceptance of group norms, and prioritization of group goals [2]. Preference for groups and reliance on a group are the two facets of psychological collectivism that were utilized in the annual survey for SSE students.

The 2017 survey was composed of 46 Likert-scale questions and three open-ended questions. The survey consisted of seven questions to analyze psychological collectivism, seven questions on team project satisfaction, and five questions for teamwork attitudes. Eight questions were used to examine students’ perceptions of emphasis and support of teamwork, two of these related to support from professors, two of related to support from teaching assistants, three relate to support from the department, and one is about support from other faculty members. Students’ perception of their competence in teamwork skills consists of seven questions and the same seven questions are used to analyze students’ perceptions of the importance of these skills. Additionally, there are two careless responder items. Based on the qualitative analysis from the 2016 survey, four Likert-scale questions were added to the 2017 survey about students’ support for various teamwork development initiatives. The four initiatives are: more team projects, some individual grading in team-based projects, opportunities for teamwork skills training, and peer feedback opportunities. These were the most common themes found in the 2016 qualitative analysis. The three open-ended questions asked students to discuss the most significant challenges they face in the engineering program, what the department does to support teamwork skills development, and what the department could do to improve teamwork skills development.

3. RESULTS

Upon analyzing the results two key trends emerged. The first trend is in relation to the distinction between skill competence and skill importance. The second key trend is related to students’ support for more teamwork initiatives in the engineering undergraduate program.
3.1. Skill Competence vs. Skill Importance

Students’ self-reports on their competencies in the necessary skills differed from the importance they perceived these same skills to have for their future careers. The six skills examined by the survey are as follows:

Skill 1: Confront a team member that doesn’t respond to emails in a timely manner.
Skill 2: Address a team member who is not contributing their fair share to the work.
Skill 3: Confront a team member whose quality of work is not meeting the team’s standards.
Skill 4: Address an interpersonal conflict you have with a team member.
Skill 5: Step in to help resolve a conflict between members of your team.
Skill 6: Help a team member raise their skill level to meet the needs of the team.

The students perceive these skills to be important for moving forward into their future careers. However, the confidence the students have in their abilities in these skills is below the level of importance these skills hold. The students rated their overall competence of these six skills at an average of 3.55 (SD = .84) whereas the average overall rating of the importance of these six skills was 4.36 (SD = .63) as shown in Fig. 2. This gap between competence and importance is a developmental area to address.

![Fig. 2. 2017 Overall Perceived Competence & Importance](image)

3.2. Support for Teamwork Initiatives

Students were asked to indicate their level of support for various teamwork initiatives that could be implemented in the engineering program. The initiatives included: more teamwork skills training, more peer feedback opportunities, individual grading in team projects, and more team projects.

Despite the vast amount of teamwork opportunities already provided by the SSE students overall indicated high support for teamwork initiatives. The highest support was found for more peer feedback opportunities (M = 3.82, SD = 1.21), individual grading for team projects (M = 3.71, SD = 1.21), and more teamwork skills training (M = 3.64, SD = 1.13). More team projects yielded moderate support from the students yielding an average response of 3.14 (SD = 1.22). These findings highlight that students recognize the utility of team projects and are open to the addition of more teamwork initiatives.

4. FUTURE RECOMMENDATIONS

4.1. Teamwork Development Activities

Three recommendations follow the trends identified. First, actively engaging students in teamwork skills development activities. Training in teamwork skills can help minimize the gap between skill and skill importance. There are various ways this training can be implemented into engineering programs such as conflict management, team dynamics, team contracts, and constructive controversy training.

4.2. Peer Feedback Opportunities

Second, provide opportunities for peer feedback within team projects. There are two ways in which peer feedback can be used: for developmental purposes or for grading purposes. Peer feedback for developmental purposes allows students to receive valuable feedback from their teammates. The feedback students receive provides them with insights into their strengths and areas of improvement. This feedback can subsequently be used by the students to optimize their teamwork abilities in future team activities. In terms of grading purposes peer feedback can allow for a portion of the grade assigned to individual team members to be adjusted for team members perceptions of an individuals contributions. The feedback can identify any drastic differences in contributions to the project by each team member. It is important to make it clear to students before they provide feedback on their team members whether the feedback will be used for developmental purposes or for grading purposes.

4.3. Support for First Year Students

Finally, provide higher levels of support for first year students. It is important to provide students with help when it is needed and make them aware that there is support available. It is also necessary that how to access this support and help is clearly outlined to the students. Emphasizing support and how to obtain it in the student’s first year of study sets them up to feel confident moving forward in their degree. This support includes emphasizing the importance of teamwork for their
academic and future careers and that there is help available if they are struggling with teamwork. Providing support resources for students is important to help them maximize their performance however, even more critical is students’ awareness of the resources so that they may be able to utilize them and subsequently benefit from them.

5. CONCLUSION

Working effectively individually and as a member of a team is an essential skill as outlined by ECAB in their 12 Canadian Graduate Attributes necessary for program accreditation.

Assessments done at the University of Calgary in the Schulich School of Engineering provides insights into key trends found among students in their perceptions of teamwork. Based on the student insights recommendations to optimize student learning of necessary teamwork skills follow.

Key trends found in SSE based on student insights are as follows. First, there remains to be a gap between the importance students believe teamwork skills to have and the competence they believe themselves to have in those same skills. The second trend found is student support for more teamwork initiatives in their engineering program. Teamwork initiative including team skills training, peer feedback, and individual grading in team projects.

Recommendations made to address these trends are teamwork development activities, more peer feedback opportunities, and emphasis on support for first year students. Student perceptions are important to consider when assessing the development of the Individual and Team Work attribute required by ECAB for program accreditation. Thus, it is important to continually re-assess student perceptions to evaluate the development of the teamwork attribute. Any necessary changes that are made evident by such assessments should be implemented. Continued re-assessments allow for the implemented changes to be evaluated to determine their successfulness.

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