International Journal of Engineering Education Vol. 31, No. 4, pp. 953–966, 2015
Printed in Great Britain

0949-149X/91 $3.00+0.00

Gender-Based Teams: Perceptions of Team Satisfaction and Effectiveness among Engineering Students in the United Arab Emirates*

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The development of teamwork skills is an important aspect of engineering education as the interdisciplinary nature of the industry requires graduates to be able to work professionally with others in a team-based environment. Any miscommunication or obstruction from team members can result in lower team performance, thereby affecting the overall goal of the team. With this in mind, many engineering programs have designed their courses to address the teamwork component in engineering. Engineering design courses in particular often focus on teamwork as an integral part of the course in an effort to prepare the students for their careers. The current study addresses the perceptions of team effectiveness and team satisfaction among students working in same-gender teams on two separate campuses of an engineering university in the United Arab Emirates (UAE). Many universities in the Middle East have gender-segregated campuses to promote education while respecting traditional Islamic norms. While the specific execution may differ, the authors anticipate that the results could be translatable to any team-based engineering course in the region. Based on the current study, female students rated themselves as more effective in their teamwork than male students, while male students were more as satisfied with their teams as a whole than female students. Female students also gave higher scores on peer evaluations than male students. In both cases, however, student assessment of individual team members in the peer evaluation was higher in the intermediate course than in the introductory course. Student interviews provided additional insights regarding team processes in UAE university classrooms. The present study provides an exploratory analysis of team effectiveness and satisfaction in this unique sociocultural environment.

Keywords: gender-based teams; culture in engineering; teamwork in engineering education

1. Introduction

Engineering is a discipline that requires a high level of teamwork. Due to globalization and the changing work environment, engineering graduates are expected to possess professional "soft" skills as well as technical knowledge [1]. In the engineering industry, organizations rely heavily on effective teamwork to address product design and development, as well as manufacturing processes [2]. Thus, teams are an integral part of the working environment and successful engineers must be able to handle projects that do not necessarily have distinct technical boundaries [3]. In developing its engineering accreditation criteria, ABET reaffirmed the need to teach the traditional technical skills, but also introduced a set of six professional skills that engineering graduates would need to be able to be successful in the industry. Teamwork was identified as one of these important professional skills [2].

Although engineering education has recognized the shift to include the development of professional skills in the curriculum, teaching professional skills such as teamwork can be a challenging task. Student teams often have logistical concerns balancing team activities with other tasks, time management and schedules issues, as well as conflicts among team members which may affect the quality of team products and processes [4]. Balancing content teaching with soft-skills training can be a difficult task for instructors as well. In a study sponsored by BP [5], soft skills such as teamwork, communication and the ability to learn, were noted as the most important skills for engineers to possess—more important, in fact, than technical knowledge. Despite these perceptions, participants in the study felt that they were not being adequately prepared by universities to improve these professional skills.

Addressing the development of professional skills in the classroom requires a paradigm shift that emphasizes "active, project-based learning, horizontal and vertical integration of subject matter, the introduction of mathematical and scientific concepts in the context of application, close interaction with industry, broad use of information technology, and a faculty devoted to developing emerging professionals as mentors and coaches

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* Accepted 27 February 2015.

rather than all-knowing dispensers of information'' [2]. Integrating technical and professional skills in the classroom, thus, involves a change in the traditional learning environment. This includes balancing the time spent on both technical and non-technical material, developing curriculum that incorporates both ''hard'' and ''soft'' skill areas, and addressing interpersonal team issues [6]. Project-based learning, facilitation in place of lectures and the use of simulations that mirror real world experiences are some of the ways that instructors can address the development of teamwork skills [7].

Activities that employ these teaching techniques are currently being used at the Petroleum Institute (PI), an engineering university in the United Arab Emirates (UAE), especially within the engineering design curriculum. The engineering design courses at the PI use a combination of instructor-led and student-led activities that balance a traditional learning environment with the soft skills needed by global engineering graduates. As these courses fit well with the student-led paradigm, it is important to ascertain the impact of this teaching approach on students' understanding of team processes. The quality of the team experience, for example, may be affected by the perceptions that team members hold regarding group dynamics and the contributions of individual team members. Having prior experience with teamwork can have a positive effect on team satisfaction and effectiveness [8–9]. However, it is possible that this is related more to team members' experience with their assessor, rather than their prior teamwork experiences [10]. In order to better understand team processes in engineering education, the current study explores team satisfaction and effectiveness of male and female students enrolled in two engineering design courses at the PI.

2. Background to the study

Globalization of the engineering industry has prompted the need to consider the role of engineers in a larger context as the labor pool is no longer limited to highly paid professionals from the United States and other G-8 countries. As the industry is heavily influenced by global market trends such as corporate downsizing and outsourcing of personnel, engineers in the US face competition from developing countries that have begun to invest in higher education by building universities that cultivate local science and engineering talent [2]. The UAE is an example of this trend.

The UAE was established in 1971 and saw unprecedented growth in the mid-1970's due to the discovery of large quantities of oil and the increase in oil prices. The rapid transformation from small towns and villages to high-tech cities required a heavy investment in infrastructure, as well as healthcare and education for citizens of the country [11]. The United Nations and World Bank have classified the UAE as a developing nation with a high personal income for UAE citizens, and the economic forecast reflects a faster pace of development than any of the other nations in the Arabian Gulf region [12].

The country's reliance on oil and gas is weighted by its emphasis on Emiratization. Currently, UAE nationals comprise about 20% of the country's population, the rest being international expatriate workers. In order to create less dependency on foreign workers, the Emiratization program uses incentives and quotas to encourage organizations in the UAE to employ Emirati men and women. One aspect of Emiratization is a focus on developing local talent through education initiatives, including free education at government universities in the UAE and generous scholarships for international institutions [13]. Because there is no gender discrimination in education (both men and women qualify for free education in government schools and universities), women in the UAE more so than men are taking up the opportunities afforded to them for higher education [14]. The number of Emirati females participating in higher education exceeds the number of males to the point that 70% of the students in higher education institutions in the UAE are women [15].

Although gender roles are slowly evolving, the UAE is inherently a patriarchal society. As the Ministry of Education dictates the system according to traditional Islamic norms, gender segregation is imposed on government institutions [12]. In order to address the increasing participation of females in university classes while abiding by traditional Islamic norms, government universities in the UAE have created gender-segregated campuses that provide instruction and support separately to male and female students interested in pursuing higher education. The Petroleum Institute (PI) is an example of an ABET-accredited government university in the UAE that utilizes the gender-segregated model of higher education.

Based in Abu Dhabi, the nation's capital, the PI was created in 2001 with the goal of establishing itself as an international institution providing tertiary engineering education and research in areas of significance to the oil and gas industries. Undergraduate degrees are offered in Chemical, Electrical, Mechanical and Petroleum Engineering, and Petroleum Geosciences. The students are admitted based on their TOEFL score and their high school GPA. Although the engineering field is still predominantly male and this is reflected in the total student popula-

tion at the PI, the number of female students continues to grow. The development of a female dormitory has further allowed Emirati females from emirates outside of Abu Dhabi to enroll at the university, thus prompting additional growth on the female campus.

3. Teamwork in engineering design courses at the PI

In their freshman year, students at the PI are required to take core courses that are irrespective of their majors. The core courses as well as some electives for the engineering programs are offered through the six departments within the Arts and Sciences (A&S) Programs (Fig. 1).

As part of the core requirement, the General Studies department offers a sequence of two engineering design courses known as STEPS (Strategies for Team Based Engineering Problem Solving). The STEPS program addresses the following educational criteria:

1. Teach principles of the engineering design process, as well as methods and tools for project management.
2. Utilize student-centered pedagogical methods for teaching engineering design and professional skills.
3. Measure the effectiveness of the course content, including technical knowledge and soft skills development.

Students take the sequence of STEPS courses in their freshman and sophomore years after they have completed two Communications courses and one Physics course as prerequisites. The STEPS program requires teams of students to respond to client specifications by designing, managing and presenting technically feasible solutions to real-world problems. In the first STEPS course (STEPS 201), students are introduced to the engineering design process and the terminology required for communication. As the STEPS 201 classes consist of a variety of engineering majors, team members often represent multiple disciplines. The second STEPS course (STEPS 251), on the other hand, is designed to provide more in-depth technical knowledge related to the different majors offered at the PI. Thus, STEPS 251 courses are divided by major and the projects that students complete are representative of their field. At times, the mechanical and electrical engineering departments may offer a multidisciplinary section that combines students from both these majors, focusing in this case on a project that requires knowledge of both disciplines.

As teamwork has been identified as one of the soft skills that is most important for work as an engineer [16], the STEPS courses are inherently based on the concept of teamwork and project-based instruction. The overall goal of the program is to introduce students to the engineering design process and integrate a range of professional skills and competencies that will simulate real-world design activities, such project management, reverse engineering, and computer aided design. As such, lectures are used only in the first few weeks of the courses to provide the terminology and skills that students need to be able to complete their term project. Instead of lectures, instructors use class time and office hours to engage in professional meetings with student teams. Instructors take on the role of the client in the design process and students are expected to maintain professional communication through the use of project management tools such as Gantt Charts, Linear Responsibility Charts, and Project Completion Matrices to demonstrate their progress. Therefore, in order to be successful, students must be actively engaged in teamwork, organization, planning, research, and problem solving. During the semester, students also regularly present the results of their project work using oral, written and graphical communication [42].

The progress and development of each team project and each student's contribution is closely monitored and evaluated by qualified engineering design experts and qualified English communication specialists for the purpose of providing helpful feedback and advice to improve project work and

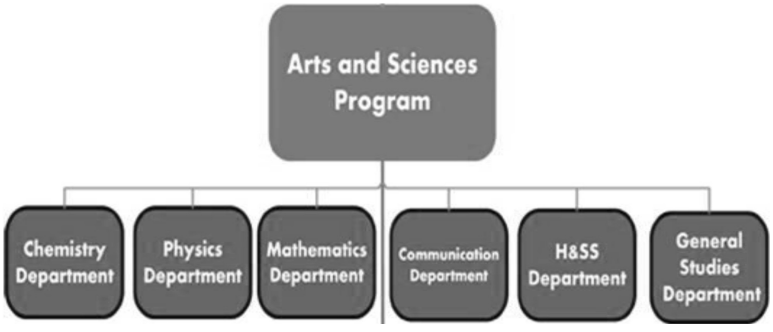

Fig. 1. Structure for A&S programs at the PI.

teamwork skills. The course focuses on team processes and so, half of the assignments are assessed with team grades. Lectures are kept to a minimum while interdependency and time management are emphasized. Students are encouraged to utilize their time efficiently, both during and after class hours, for designing their team project. In general, team members are chosen randomly by instructors and team membership is not negotiable or transferrable during the semester.

4. Gender-based teams

Demographic characteristics and patterns of social interaction have been shown to influence team effectiveness through quality of team processes and improved team performance [17]. As the teams at the PI are gender-segregated and culturally homogeneous, it is important to ascertain how much influence homogeneity may have on teamwork.

Research on homogenous versus heterogeneous teams provides some context for understanding single gender team processes. A meta-analysis of homogenous and heterogeneous teams found a slight preference for heterogeneous groups, but noted that the statistical significance obtained by the individual studies depended on the type and difficulty of tasks in each investigation [18]. Homogenous team members generally show greater affinity for their team than heterogeneous team members [19]. Often in moderately heterogeneous teams, sub-groups tend to form based on perceived commonalities [20]. Baugh and Graen [21] found that gender-based teams (all-male or all-female) perceive themselves as more effective than heterogeneous teams. As task interdependence is a factor in effective teamwork [22], it is possible that single gender teams offer a greater degree of comfort for communication among team members to address the tasks needed. In Arab communities in the Middle East in particular, gender homogeneity and communication patterns among gender-segregated groups may enhance this phenomenon. Feghali [23] notes the importance of physical space, which tends to be closer in all-male or all-female situations as contact and touching between genders is considered offensive in public spaces. Status in the community, as a result of age or tribal affiliation, is another factor that influences communication patterns.

Female teams in particular seem to want control over group membership [4, 24]. However, in a study of team development, Mohammed and Pasha-Zaidi [43] found that female teams that are not given the choice of group membership appear to form more cohesive relationships. This is an important aspect to consider as team cohesion has a positive effect on team processes [25]. Even in teams that are formed through randomized allocation, time spent together working in a team seems to have a positive effect on perceived effectiveness. In an experimental study of female engineering students in the UAE, Pasha-Zaidi and Mohammed [4] noted an increase in perceived effectiveness of teams over the course of a semester. Perceived effectiveness focused on students' perceptions of their team deliverables whereas satisfaction with the team focused on students' perceptions of their team processes. In line with these ideas, our study aimed to investigate the following research question:

What are the effects of STEPS courses (STEPS 201 and STEPS 251) and gender on students' perception of their team satisfaction and effectiveness in STEPS classes?

5. Methods

5.1 Participants

The study was conducted during the 2013–2014 academic year. A total of 190 students (104 males and 86 females) participated in the study. All participants were enrolled in one of the STEPS courses. At the beginning of the semester, students were placed into teams of 4–5 members, depending on class enrollment numbers. A total of 45 teams participated and team membership was based on random assignment. A smaller sub-group of students (23 males and 14 females) further agreed to participate in individual interviews regarding their team process.

5.2 Procedure

In both STEPS courses, students worked with the same team members for one semester on a variety of engineering design projects. At the end of the semester, participants were asked to complete a survey discussing their team experiences (Appendix A). The following items were used to measure perceptions of team satisfaction and effectiveness:

(a) How satisfied are you with your STEPS team?
(b) How effective is your team?

Both items used a 5-point Likert scale. The choices for team satisfaction ranged from 1 (Very dissatisfied) to 5 (Very satisfied). Similarly, the choices for team effectiveness ranged from 1(Highly ineffective) to 5 (Highly effective). Students were also asked to explain their choices regarding their perceptions of team satisfaction and effectiveness.

The use of two single-item measures was deemed appropriate for a variety of reasons. Single item

measures have been used to gain information about global constructs, such as job satisfaction, and have been shown to correlate with multiple item measures [26]. Although single item measures cannot differentiate between the dimensions of a construct, they are often used with constructs that are generally unambiguous [26] or for cases in which convenience and expediency are key [27]. As a variety of instruments were being employed for data collection in this study, it was important to limit survey fatigue and use items that could be quickly and conveniently administered to measure these global constructs. By including a qualitative section asking for explanations of their responses to the two single-item measures, the researchers were further able to gather information to support the responses.

As peer assessment has been shown to be a more effective learning tool than self-assessment or instructor formative feedback [46], the current study also utilized peer evaluations as a way to collect data on the teamwork component of the two design courses (Appendix B). The peer evaluations were integrated into the grading schema of both courses (accounting for 5% of the students' final grade) to encourage accountability and allow students the opportunity to assess the contributions of individual team members. Peer evaluations asked students to rate themselves and their team members on five behavioral categories: quality of technical work, ability to communicate, ability to provide leadership, commitment, and demonstrated effectiveness. Students used a 5-point Likert scale to indicate how often they felt that they and their teammates exhibited the behaviors indicated. Response choices ranged from 1(Never) to 5 (Always), with 25 being the highest score that a team member could receive on each evaluation. In order to maintain the 25-point grading scale, peer evaluation scores for each team member were added together and then divided by the number of team members that participated in the evaluation. Finally, a convenience sample of team members was interviewed individually to gain insight into the student ratings on the peer evaluations. Students in the convenience sample represented both STEPS 201 and STEPS 251 sections.

5.3 Data analysis

The research team used a one-way multivariate analysis of variance (MANOVA) to analyze responses to the two single item measures of team satisfaction and team effectiveness. In general, an analysis of variance (ANOVA) tests for significant differences between means. A MANOVA assesses whether there are any main effects or interaction effects of independent variables on two or more dependent variables. The Wilks' Lambda is the most common statistic used for overall significance and measures the percent of variance in the dependent variables that is not explained by the differences in the levels of the independent variable. In the current analysis, gender and STEPS courses were considered as independent variables and team satisfaction and effectiveness scores were considered as the dependent variables. A univariate analysis of variance (ANOVA) was then performed for peer evaluation scores using gender and STEPS courses as the independent variables and peer evaluation as the dependent variable. The ANOVA separates the variation in the data into two parts—between-groups variation and within-groups variation. This is known as the sum of squares (SS). The F-ratio is calculated by dividing the mean between-groups SS by the mean within-groups SS. Finally, a p-value of less than 0.05 indicates that there is a statistically significant difference between the groups being tested.

The analyses in the present study were performed using the significance level of 0.05 using the Statistical Package for Social Sciences (SPSS) 22. Qualitative analysis of the comments provided by students on the survey was completed using a thematic approach where student responses were categorized according to the emergent themes identified by three of the researchers. Finally, analysis of student interviews provided additional insights into team processes.

6. Results

6.1 Team effectiveness and satisfaction

A summary of one-way MANOVA results comparing mean scores according to gender and STEPS course with respect to the dependent variables is displayed in Table 1. The results revealed a statistically significant difference between males and females on the dependent variables, $F(2, 185) = 4.873$, $p = 0.009$; Wilks' Lambda = 0.950; partial eta squared = 0.050. Based on Cohen's classification of effect size, with 0.01 representing a small effect, 0.06 being a medium effect and 0.14 being a large effect [47], the partial eta squared (0.05) indicates that the main effect of gender on the dependent variables is small. As indicated in Table 1, there was no statistically significant difference of satisfaction or effectiveness ratings based on STEPS course and there was no statistically significant interaction effect of the two independent variables (Gender*STEPS course) on the dependent variables.

Descriptive statistics showed that female students rated themselves as more effective in their teamwork than male students. Male students, on the other

Table 1. MANOVA summary for comparing mean scores with respect to gender and STPS course

Source	Wilks' Lambda	*F*	*p*	*Partial Eta Squared*
Gender	0.950	4.873	0.009*	0.050
STEPS Course	0.987	1.251	0.289	0.013
Gender*STEPS Course	0.973	2.564	0.080	0.027

* Note. Analysis was performed with the significance level of alpha = 0.05.

Table 2. Descriptive statistics for the gender and STEPS course with respect to Group Effectiveness and Satisfaction with the group

		STPS201		STPS251		Total	
		Mean	SD	Mean	SD	Mean	SD
Group Effectiveness	Female	4.08	0.781	4.36	0.653	4.19	0.744
	Male	4.00	0.764	4.00	0.882	4.00	0.824
	Total	4.04	0.770	4.14	0.819	4.08	0.792
Group Satisfaction	Female	3.53	1.120	4.06	0.704	3.73	1.011
	Male	4.02	0.721	3.91	1.093	3.96	0.934
	Total	3.76	0.977	3.97	0.964	3.86	0.974

hand, were more as satisfied with their teams as a whole than female students (Table 2).

Themes that emerged from the qualitative analysis of team satisfaction scores included helping behaviors, focus on project outcomes or grades, productivity, comprehension of the task, technical skills, and team organization. Male students considered project outcomes as the most influential factor in their satisfaction with their team, followed by helping behaviors exhibited by team members, such as cooperation and collaboration. Female students, on the other hand, based their satisfaction with their team mainly on the presence or lack of helping behaviors among the team members. Fig. 2 shows the results of the qualitative analysis for satisfaction scores.

With regards to team effectiveness, male students chose team organization factors, such as division of work load and time management, as most influential for their team's ability to effectively perform the given tasks. The project outcome or grade was another important factor in their perception of team effectiveness, as well as the productivity in their team. Productivity included hard-working members and persistence of effort. Female students, on the other hand focused mainly on helping behaviors, followed closely by the productivity of their team members. Fig. 3 shows the effectiveness

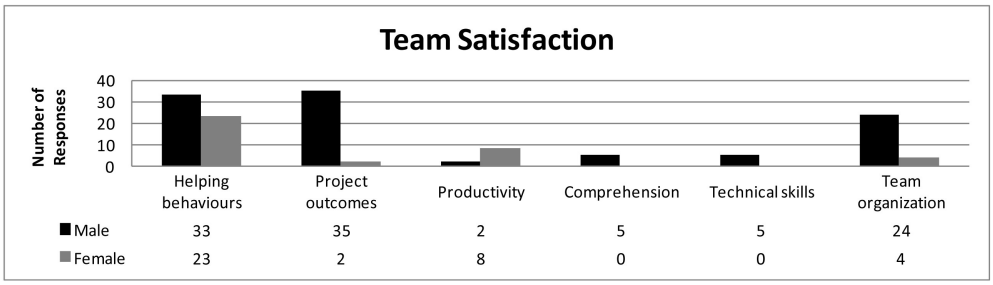

Fig. 2. Team Satisfaction Scores of male and female students.

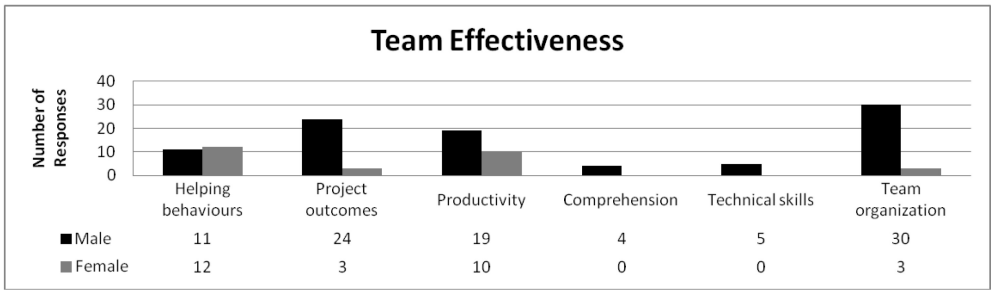

Fig. 3. Team Effectiveness Scores of male and female students.

Table 3. One-way ANOVA results (*F* ratio and eta^2 statistic) for student gender on peer evaluation score

Source	*df*	*F*	*p*	*Partial Eta Squares*
STEPS	1	12.51	0.001	0.09
Gender	1	4.90	0.03	0.04
Gender * STEPS	1	2.15	0.15	0.02
Error	131	(16.65)		

Note. (a) Computed using alpha = 0.05, Value in parenthesis represents mean square error.
Dependent variable = peer evaluation score.

Table 4. Descriptive statistics for student gender, STEPS course, and peer evaluation score

Student Gender	STEPS Course	Mean	Standard Deviation	N
Male	STEPS 201	19.41	5.04	41
	STEPS 251	21.09	2.24	23
	Total	20.02	4.31	64
Female	STEPS 201	20.02	4.31	57
	STEPS 251	24.06	0.95	14
	Total	20.81	4.20	71
Total	STEPS 201	19.77	4.62	98
	STEPS 251	22.21	2.35	37
	Total	20.44	4.26	135

scores of male and female students based on the qualitative feedback from the surveys.

6.2 Peer evaluations

A one-way between-groups analysis of variance was conducted to explore the impact of gender on peer evaluation score. ANOVA results comparing mean scores on the peer evaluations according to gender and STEPS course are shown in Table 3. There was a statistically significant difference in peer evaluation scores based on student gender, $F(1, 135) = 4.90$, $p = 0.03$, as well as STEPS course, $F(1, 135) = 12.51$, $p = 0.001$.

Descriptive statistics showed that female students rated themselves higher than male students on their peer evaluations both in STEPS 201 and STEPS 251 courses (STEPS 201: $M = 20.02$, $SD = 4.31$ for female students and $M = 19.41$, $SD = 5.04$ for male students) and (STEPS 251: $M = 24.06$, $SD = 0.95$ for female students and $M = 21.09$, $SD = 2.24$ for male students). Additionally, STEPS 251 students rated themselves higher on the peer evaluations than STEPS 201 students (STEPS 251: $M = 22.21$, $SD = 2.35$ and STEPS 201: M=19.77, $SD = 4.62$). Descriptive statistics are shown in Table 4.

6.3 Student interviews

Interviews with team members consisted of justifications for the peer evaluation scores they had provided as well as discussions regarding the team process that semester. Due to the large number of responses in this part of the study, representative comments are used to support the emergent themes.

During the interview sessions, students identified the names of the team member or members that contributed most to the team (usually the team leaders) as well as students who did not perform well. Students who were interviewed were particularly critical of team members who they felt did not put in their best effort. In many cases, students felt that their own effort was more than the effort of other team members. They also acknowledged that when team members did not perform their tasks, it forced the remaining members to put in extra effort. The following comment from a male student in STEPS 251 speaks to this: ''AAH did not attend any team meetings. When I call him, he does not answer. You saw what happened with the research assignment. His work was terrible. We couldn't use it. So we had to do the work twice.''

In some cases, researchers noted a struggle for leadership and control. A female student in STEPS 201 made the following comment: ''AAK is our team leader, but she doesn't share her work. My part depends on her part. So, I'm waiting and she says she won't let me see her part. I don't know why.'' Respectful communication between team members was another key element, as evidenced by the following comment from a female student in STEPS 201: ''She's always complaining and being rude. ALA was crying the last week because AAM called her and yelled at her for not doing her work properly.'' A male student in STEPS 201 noted a similar tendency in his team, ''You know AAL. He always thinks he is right and he doesn't listen to anyone. I want to do my part, but I don't know if he will include me because he wants to do everything.''

All team members who were interviewed highlighted their own participation and effort. Students who were labeled as less effective team members

often did not acknowledge this in their own interviews. In one case, a male student in STEPS 251 complained that he did not participate as much as he would have liked because he felt that the team did not want his help. ''My team members don't like me. I did my part, but then it was lost. So, I couldn't get it done in time (again) because it was after 8 o'clock, and then I have family to take care (of). So I didn't do it. Now, they don't want me to do anything, so I don't participate.''

Despite complaints about certain team members, however, researchers conducting the team interviews noticed a tendency of both male and female students to ask instructors to ''be kind'' to their teammates when assigning grades. The following comment from a male student in STEPS 251 speaks to this: ''I don't think he deserves the (team assignment) grade because he did not do anything this semester, but if my (course) grade is higher, it's ok.'' Another tendency noted by researchers was the hesitance of team members to address conflict openly. They preferred to talk to instructors in private and ask for their intervention in addressing areas of contention in their teams, but they did not want others to know that they had done this. As one male student in STEPS 251 pointed out, ''I need to work with these guys in my other classes, so I can't let them know that I complained. They will not work with me if I have this reputation.'' Students also focused on the impact of team grades on their own class marks. A female student in STEPS 201 noted, ''If I don't do all the work, my marks will suffer. My team members do not want to work, so I have to do it.''

On a related note, some students also stressed the importance of creating their own teams, rather than working with randomly assigned team members. A female student in STEPS 201 commented, ''It is not fair. I know who works and who doesn't. If I work with my friends, we can get everything done because I know them and I can work better with them.'' Other students preferred random assignment. A female student in STEPS 251 noted the following: ''Random assignment is better. If I work with my friends, they might make me do all the work, and I will feel shy to tell them to do their work.''

7. Discussion

The present study adds to the extant literature on gender and team processes by focusing on team effectiveness and satisfaction within two engineering design courses at an engineering university in the Middle East. The university offers separate campuses for male and female students, but the course requirements for graduation remain the same and professors may teach on either or both campuses. The cultural climate of the locals in the country is evolving and depicts a blend of traditional patriarchal norms with an increasingly educated female populace. STEM education is considered a valuable asset for the national economy, which continues to be heavily dependent on the oil and gas industry. As students perceive STEM as an empowering field for women in particular [28], the results of the present study support the notion that females would perceive their performance in female-only teams as more effective than males.

A study of female engineering students in the UAE [29] found that students who had more confidence in their mathematical abilities were more likely to pursue engineering degrees. As female participation in STEM education is considerably less than male participation, it is possible that women who join a STEM program are more motivated to achieve than their male counterparts. Being in a gender-segregated campus that is geared towards the engineering discipline may also provide female students with greater support in their academic pursuits. By not having to compete with male students in a male-dominated field of study within a patriarchal society, female students may feel empowered to achieve greater gains from their coursework. Thus, their level of effort may be greater, which in turn may result in higher ratings of team effectiveness for courses such as STEPS, which are heavily dependent on team interaction. Both the survey results and the peer evaluation scores in the current study support this notion as female students on both measurement tools rated themselves higher than male students.

Furthermore, the group identity for the female students in the present study may be more cohesive due to their unique position as women studying engineering in the UAE. Female engineering students in the UAE are not only an anomaly in the larger field of engineering, which continues to be a male-dominated industry; but they are also part of the cohort of women that are pursuing higher education in a traditionally-patriarchal community. Thus, they must contend with gender stereotypes that are prevalent in the STEM discipline [30–33] as well as the demands of a cultural background that is undergoing immense change. Although women account for over 70% of the students in undergraduate programs in the UAE [34], female students continue to struggle for support from family in pursuing their career goals [35]. Although female participation in higher education surpasses male participation in the country, the number of women in the workforce remains stagnant at about 20% [36].

As a collectivist society [37], the UAE promotes relationships over individual achievement [38]. In

fact, emphasizing individual growth may be considered a way of promoting discord, if it interferes with family harmony. Thus, the focus of higher education in many cases is on improving a woman's ability to gain better marriage prospects. In this view, educated women serve as better role models for the next generation [39]. So, the ultimate goal for women is not to provide for the financial well-being of their families, but rather to balance their work and home responsibilities [35]. These push-and-pull factors, which are unique to the female students in the present study, may have played a role in creating more cohesive teams, leading to the perception of greater effectiveness among the female students compared to the male students.

Although grades are the primary way of defining the effectiveness of a team's performance, interestingly, the female teams in the current study based the reasons for their perceived effectiveness predominantly on the presence or lack of helping behaviors that they noted in their teams. This may be one explanation for the lower levels of satisfaction that female students perceived with regards to their team processes. While they rated their teams as more effective than male students, the total satisfaction rate of female teams based on ratings in both STEPS courses indicates that, overall, they were less satisfied with their teams than male students. Their team satisfaction did go up from the introductory STEPS 201 course to the STEPS 251 course. A greater degree of experience working in teams may account for this trend [8]. It is possible that female students, especially in the introductory course, were less experienced with conflict resolution strategies. This coupled with a motivation to receive high marks may have attributed to a less satisfactory experience in their teams. However, as their experience with team-based projects grew, they may have been able to better articulate their priorities and handle conflict, thereby creating a more psychologically-satisfying work space.

The male students in the present study perceived their effectiveness to be lower than the female students. A variety of reasons may explain the gender difference in team effectiveness scores. In a study of gender diversity and quality of teamwork, Rogelberg and Rumery [40] found that the all-female groups outperformed the all-male groups. Thus, the gender gap for effectiveness in same-gender teams seems to support prior research. Additionally, unlike the female students in the study, the male students predominantly judged their team effectiveness on the project outcomes. This was followed by the helping behaviors they observed in their teams and the organizational aspect of their teamwork. The male students were also concerned with task comprehension and technical skills of the team members, neither of which were mentioned as factors associated with effectiveness among the female participants.

Emiratization policies may be another factor that affects teamwork. The local students at the PI are guaranteed a job after graduation, which eliminates the competition that most college graduates face once they have received their degrees. It is possible then that the male students in the present study felt less pressured in their courses. Thus, they may have found greater satisfaction with their team processes as their expectations for success may have been lower than the female students. However, the trend for team satisfaction for males in the current study suggests that male students' level of satisfaction decreases from the introductory STEPS course to the intermediate one. As the results were not at a statistically significant level, this trend may be due to chance or to the composition of team members in both courses. The trend may also be explained by the higher level of work expected in the intermediate course. Completion of higher cognitive tasks requires more effort. As the mean effectiveness scores of the male students remained the same in both courses, it is possible that students felt increased pressure to perform in the intermediate course, but were unwilling or unable to increase their effort. This would account for the decrease in satisfaction with their teamwork, especially as the male students focused on project outcomes as the main factor affecting their satisfaction with the team.

Interestingly, when comparing peer evaluation scores in STEPS 201 and STEPS 251, both males and females tended to give team members higher ratings in the upper level course. As female students felt that they were more effective than male students and their satisfaction level went up from one course to the next, it is not surprising that the peer evaluation scores reflect the same trend. However, given that male students reported less satisfaction in STEPS 251 and their mean effectiveness ratings remained the same in both courses, the allocation of higher peer evaluation scores in the upper level course is an interesting phenomenon. An explanation for this may be found in the student interviews. As the researchers conducting the interviews noted, students were generally forgiving of their team members when it came to actual grades on specific assignments. Although they would complain about peers who they felt were not contributing their best effort, most students did not want this to result in lower grades for their team members. Instead, the interviews showed that students wanted instructors to be "kind" in their evaluations, even with team members that were not performing effectively. This may be even more pertinent in upper level courses as

students may be more conscious of the effect of their course grades on their overall grade point average. As the peer evaluation score was directly linked to individual team members and accounted for 5% of their final grade, it is possible that despite their holistic perceptions of team satisfaction and effectiveness, male students in STEPS 251 were less willing to give low peer ratings to specific people on their team. This is further supported by the fact that the mean score of peer evaluations for both STEPS 201 and STEPS 251 were relatively high anyway.

Student interviews captured some of the nuances of team interactions in the present study. Many of the student comments reflected the collectivist nature of the culture in the UAE where succeeding together is the ultimate goal and saving face is essential [45]. This is an important aspect to consider when teaching in the UAE. Although students are willing to give feedback on their team processes to instructors, they are generally hesitant to resolve conflicts directly with other team members. Instead, they prefer instructors to serve as intermediaries. This may lead to problems in communication when team members are required to resolve conflicts on their own. Instructors working in the UAE may, therefore, find it helpful to act as a mediator with struggling teams early in the process, thereby providing a safe environment where team members can learn to use appropriate strategies for professional interaction. By helping students focus on the task at hand, instructors can guide students to depersonalize conflicts and allow students to keep face, while encouraging all team members to actively participate in the team process.

Maintaining regular contact with student teams may be particularly helpful as it can indicate the level of participation of each team member as well as their level of understanding. The interviews in the present study indicated that students are likely to emphasize their own efforts in the team process, while downplaying their areas of weakness. As regularly scheduled team meetings are integrated into both STEPS 201 and STEPS 251 courses, professors have the opportunity to provide frequent and immediate feedback to gauge student participation and learning throughout the project. These meetings can help instructors monitor student performance so individual team members can be held accountable for the quality of their contributions, or the lack thereof. Team meetings with instructors can also highlight individual behaviors within the team setting so instructors can determine if any team members are dominating the discussion or whether any potentially disruptive subgroups are forming that may threaten the cohesiveness of the team as a whole [44]. Thus, identifying and monitoring these elements of the team process can be helpful for students and professors alike.

Results from the present study indicate that the relationships between team members had a greater effect on female students' perceptions of team performance and processes compared to male students, who generally focused more on task-related variables. This is an important finding as it illustrates how perceptions of teamwork may be influenced by the different ways in which gender-based teams assess their ability to perform group tasks. It may also have implications for instructors working with gender-based teams in the UAE and other Gulf Arab regions. Understanding that all-female teams may be more relationship-oriented whereas all-male teams may be more task-oriented provides a lens into the ways in which instructors can approach team-based projects. For example, instructors in UAE universities may consider employing more team-building activities with female teams, especially in the early phases of team formation, to help female students build rapport with their team members and create shared experiences. Team "entitativity", or the degree to which team members form cohesive bonds [41], may be a particularly important aspect to consider with female teams in the UAE. Task-oriented activities, on the other hand, may be more beneficial for all-male teams. Providing clear expectations of team deliverables and emphasizing organizational tools that help students identify project milestones and deadlines may help all-male teams improve their performance on team-based projects.

8. Limitations

As students in this particular study represent a convenience sample of students who were already enrolled in the STEPS 201 and STEPS 251 courses, it is possible that the results convey a phenomenon that is particular to the students being studied. Further research and replication of the study are needed to ascertain whether these results can be generalized to other student populations at the PI or at other institutions of higher education in the Middle East.

9. Conclusion

The present study adds to the current literature on team processes by focusing on the perceptions of gender-based teams in STEM education within the UAE. As the UAE is heavily dependent on the oil and gas industry, the need to develop engineering professionals continues to be a priority for the country's economic growth. Additionally, given the influence of the Arabian Gulf region on the

world's supply of oil and gas, it is important to gain more knowledge about the ways in which educational programs are developing the next generation of engineers for the Middle East region and beyond. As teamwork is an essential component of success in the industry, engineering universities such as the PI are incorporating teamwork and project-based learning to build students' professional skills.

Although women may be working in mixed gender groups once they graduate, the current educational system of government universities in the UAE provides gender-segregated facilities that allow students to gain the educational background while adhering to traditional Islamic norms. Thus, single-gender teams are the norm at the university level for students attending government institutions in the UAE. In order to better facilitate the development of teamwork skills, engineering instructors working in gender-segregated campuses must be aware of the ways in which all-male and all-female teams' function. The current study provides an exploratory analysis of team effectiveness and satisfaction in this unique sociocultural environment. As such, it sheds light on the perceptions that single-gender teams may hold regarding their team processes and highlights the cultural and societal norms that need to be considered when discussing teamwork in the context of UAE higher education.

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Appendix A

STEPS Perceptions of Team Effectiveness Survey

Age _____

Gender : Male Female

Nationality _____

Year at the PI : Freshman Sophomore Junior

Which STEPS course did you take this semester? (Circle one): STEPS 201 STEPS 251

Section Number: _____
Your Team Name: _____

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1. How satisfied are you with your STEPS team? (Please circle one)

   Very dissatisfied Dissatisfied Neutral Satisfied Very Satisfied

   Please explain your choice

   _____

   _____

   _____

2. How effective is your team? (Please circle one)

   Highly effective Moderately Effective Somewhat Effective Ineffective Highly Ineffective

   Please explain your choice

   _____

   _____

   _____

Appendix B

STEPS Final Team Work Evaluation Form

Instructions:

This form is designed to help you rate the team members in your class project. Begin by writing down your name and the project or team name. Use the rating scale to evaluate your team members against the criteria defined at the bottom of the page. Write ratings and add them together for each team member, including yourself, in the table below.

Your name: _____

Name of project or team: _____

Use the following rating scale to evaluate your team members' behavior in each of the following criteria A through E:

1	2	3	4	5
Never	Sometimes	Many times	Most of the time	Always

Team Member	**Rating Criteria**					
	A	B	C	D	E	Total
1. Yourself						
2.						
3.						
4.						
5.						
6.						

Definition of rating categories

A. Quality of Technical Work:	Is the work correct, clear, complete, and relevant to the problem under discussion? Are equations, graphs, and notes clear and intelligible?
B. Ability to Communicate:	Do you understand what's being said? Are you clearly heard? Is the team's direction clear?
C. Ability to Provide Leadership:	Does she/he take initiate activities, make suggestions, provide focus? Is he/she a sparkplug?
D. Commitment to Team, Project:	Does she/he attend all meetings? Arrive promptly? Prepared? Ready to work?
E. Demonstrated Effectiveness:	Has he/she done what's been promised? Could this project have benefited from more (or less) of this person's contributions?

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