

Transforming Student Groups into Effective Teams: Utilizing Human Dimensions to Maximize Student Success

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Instructors find it challenging to assign students into teams due to logistics and the negative perception about teamwork held by students. Use of human dimensions in assigning teams can be an effective solution as it can help improve compatibility among students. Identification of traits that are the key differentiators in team performance could also serve to reduce the amount of time and effort spent by instructors in sorting students into teams. This study administered HEXACO Personality Inventory – Revised (HEXACO) and Emotional Intelligence Appraisal to 60 student teams with three or more members to explore whether there was a difference in performance of teams with varying levels of HEXACO and Emotional Intelligence personality traits. Analysis of the data using Mann-Whitney U test revealed extraversion, agreeableness, and altruism to be differentiating factors in performance. In addition, a stepwise regression was conducted to formulate a predictive model of team performance. The predictive model included agreeableness, self-management and relationship management. However, previous findings indicate that predictors of team performance may not be consistent for all courses. Therefore, a suggestion is made that it may be worthwhile for instructors to create a predictive model of team performance for every course that uses teamwork and is administered in a different format.

Key Words: student success, group work, personality traits, team success, high performing

Introduction

Teamwork is a commonly employed pedagogical technique in most educational systems including construction management. It has been found to facilitate learning, especially in the area of academic knowledge (Baines *et al.*, 2007, Hammar Chiriac, 2014; Johnson and Johnson, 2004). Another commonly cited benefit of teamwork is promotion of students' abilities to function as a cohesive group such as social training and interpersonal skills (Baines *et al.*, 2007, Hammar Chiriac, 2014; Johnson and Johnson, 2004). A study by LaBeouf, Griffith, and Schultz (2014) found that teamwork prepares students for future positions in the workforce, helps students develop individual skills and has applications for future work.

Despite the numerous benefits associated with it, teamwork can be seen with dread by students and faculty alike. While teamwork is defined as "pupils working together as a group or a team" (Blatchford *et al.*, 2003, p.155), the reality may often be far from it. Three primary challenges associated with teamwork are coordination costs, motivation costs, and intellectual costs (Carnegie Mellon University, 2018). Coordination costs represent the increased amount of time and energy associated with activities such as coordinating schedules, arranging meetings, making collective decisions, and integrating individual contributions of team members. Motivation costs are those that adversely impact a student's motivation of working in team. A common example of motivation cost is free riding, where most of the work is done by a few diligent members of the team, although all members of that team gets the same score. Conflicts are another major challenge that impedes the motivation of students to work as a team. Intellectual costs refer to characteristics of group behavior that impedes creativity and productivity of the overall team.

Team Formation

Some instructors often find it challenging to create balanced teams in such a way as to set them up for success, while mitigating the commonly held negative perceptions about teamwork among students. Yet others feel that the goal is to help students adapt when the team is not set up to succeed. This paper addresses the former challenge of creating optimized student teams. The commonly employed strategies for forming student teams presently are random assignment, self-selection by students, and instructor-generation of teams (Baeplar *et al.*, 2016). Random formation of teams is supported by research as being the simplest and the most efficient method (Nilson, 2010). However, there is no consensus in the research about the effectiveness of randomly assigned groups in terms of student performance. Self-selection of students into teams of pre-determined sizes has been found to cause imbalance in team members' academic ability and resources (Oakley *et al.*, 2004, Michaelson *et al.*, 2004). Instructor-generated teams, on the contrary, have been found to be the most likely to result in a balance of member resources across teams. (McKeachie & Svinicki, 2014). However, this approach may be logistically challenging for instructors. Online tools such as Comprehensive Assessment of Team Member Effectiveness (CATME) assist instructors to form teams more deliberately, while providing resources for the team members to collaborate effectively.

Among several methods, the use of human dimensions in assigning teams have been gaining momentum in recent years, in both academic and professional settings. However, the field of study is not as sophisticated as others such as software (Howard, 2001; Rasch and Tosi, 2009) and the military (Halfhill *et al.*, 2005). A few studies have looked at how team personality composition impacts team success among students (Bradley *et al.*, 2013; Sánchez *et al.*, 2018). Yet the results of these studies often fail to provide any single tool or finding that can be readily applied in classrooms by instructors. Another drawback to most studies in the academic setting that look at team personality is the small sample size used, which increases the chance of assuming a false premise as true (Faber & Fonseca, 2014). In addition, there is no clear understanding of how different levels of personality traits impact group performance. Thus, there is a need to further explore personality traits in the context of student teams.

Mischung *et al.* (2015) found that an optimum variation of traits associated with Emotional Intelligence within the members of a team is related to the performance of the team. Another study found that the performance of teams assigned based on Honesty-Humility, Extraversion and Overall Emotional Intelligence was significantly higher than that of randomly assigned teams (Hurtado *et al.*, 2018). A study by Shalwani *et al.* (2018) that used two prominent personality assessment instruments – HEXACO Personality Inventory-Revised (HEXACO PI-R) and Emotional Intelligence Appraisal (EI) to explore student performance found that high-performing teams have higher altruism and self-management than low performing ones. Considering the prevalence and importance of group work in academia, as well as the negative perceptions associated with it, there is a need to understand how to form good teams. For this paper, the researchers built upon previous studies and sought to explore whether the composition of a team in terms of its HEXACO and EI traits impacted their performance. In addition, the researchers intended to derive a predictive model for team performance to assist instructors in forming high performing teams.

Methodology

This study followed the methodology used by Shalwani *et al.* (2018). The sample for this study consisted of 310 students in an estimating course across five semesters at a large public university in Southwestern United States. The students were all enrolled in a construction management or construction engineering program. 3.2% ($n = 10$) dropped out of the course before the end of the semester, thereby rendering those data points incomplete. 10% ($n = 31$) of the students were part of teams that had less than three members, so they were also excluded from the analysis. After listwise deletion of the aforementioned entries, data collected from 264 students were analyzed in this study. The construction industry experience of the students ranged from zero to 35 years ($M = 1.91$ years, $SD = 3.73$ years). 91 students (35%) had less than a year of industry experience, thirty (11%) had one to two years, thirty six (14%) had two to three years, thirty (11%) had three to four years, fifteen (6%) had four to five years, 8% ($n = 21$) had more than five years of experience, and 15% ($n = 41$) had missing information.

Instruments

HEXACO PI-R is an instrument that assesses six personality dimensions obtained from lexical studies of personality structure conducted in various languages (Ashton & Lee, 2001, 2007; Lee & Ashton, 2004). The six dimensions are Honesty-Humility, Emotionality, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience. Each of these dimensions subsume four facet scales, thus comprising 24 facet-level scales. The revised version of the instrument also includes a 25th interstitial facet for Altruism versus Antagonism. The instrument is made up of 100 5-point Likert items where the respondents indicate their level of agreement with different scenarios (1 = *strongly disagree*; 5 = *strongly agree*). The responses to the instrument are computed to provide scores for every dimension and facet on a scale of 1-5.

Emotional Intelligence Appraisal developed by Bradberry and Greaves (2009) assesses four primary skills as part of two main competencies of emotional intelligence (EQ): personal competence and social competence. Personal competence includes self-awareness and self-management, while social competence includes social awareness and relationship management. The survey uses 28 behaviors and require the respondent to indicate the frequency in which they exhibit each behavior on a 6-point Likert scale (1 = *never*, 6 = *always*). The responses are used to calculate a score for each primary skill and an Overall Emotional Intelligence score. The maximum possible score for a skill in this instrument is 100.

Procedure

The students enrolled in the estimating course were asked to complete the aforementioned personality assessments at the beginning of a semester. The assessments were administered to them through an online survey platform, and up to three reminders were sent out to the students each semester. Appropriate informed consent procedures were followed in the data collection process to ensure ethical conduct of research as mandated by the Institutional Review Board (IRB). The students were then randomly assigned into small teams of 3-5 members and asked to work on a semester-long project as a team. 46.7% of the 60 teams ($n = 28$) had five members, 31.7% ($n = 19$) had four members, and 21.7% ($n = 13$) had three members.

The scores for each of the seven HEXACO PI-R dimensions (including Altruism) and five Emotional Intelligence Appraisal constructs were averaged across all the members in a team to compute a single score for each trait for a team. The variance in each trait was also identified for every team, to better understand if the homogeneity (low variance) or heterogeneity (high variance) in any trait contributed to improving student performance as a team. These were the independent variables used in the study. Each team received a single score from 0 to 100% for their project at the end of the semester. The score was based on the quality and accuracy of the project that the team turned in. The scores ranged from 54.67% to 100%, with the mean at 87.01% and the median at 87.13%.

Results

In order to better understand the central tendency and spread of the traits being analyzed in the sample data and summarize them effectively, descriptive statistics were computed (table 1). Both average traits of a team as well as the variance of the traits within a team (calculated as the standard deviation of the traits within a team) were used in this analysis.

Mann-Whitney *U* test was used to assess whether the overall personality traits of teams and the amount variance of personality traits within a team impacted team performance. This test is a rank-based nonparametric test that determines if there are statistically significant differences between two or more groups. This test was used due to the non-normal distribution of the data.

Table 1

Descriptive analysis of personality traits and their variance in teams.

Personality Trait	Overall Trait					Variance of Trait Within Team				
	Max.	Min.	Mean	Median	Std. Dev.	Max.	Min.	Mean	Median	Std. Dev.
Honesty-Humility	3.75	2.80	3.21	3.17	0.21	1.00	0.12	0.48	0.47	0.18
Emotionality	3.31	1.56	2.51	2.44	0.38	1.51	0.14	0.59	0.52	0.28
Extraversion	4.19	2.42	3.38	3.38	0.32	1.53	0.14	0.67	0.69	0.29
Agreeableness	3.92	1.92	2.77	2.75	0.37	1.56	0.14	0.58	0.58	0.26
Conscientiousness	3.69	2.17	2.99	2.95	0.30	1.42	0.00	0.60	0.58	0.27
Openness to Experience	3.52	2.35	2.91	2.90	0.23	1.19	0.12	0.43	0.40	0.19
Altruism	4.30	3.25	3.78	3.75	0.26	1.15	0.14	0.50	0.48	0.25
Self-Awareness	4.17	2.44	3.25	3.19	0.35	1.28	0.14	0.62	0.57	0.24
Self-Management	4.17	2.58	3.42	3.44	0.32	1.33	0.13	0.65	0.66	0.30
Social Awareness	3.95	2.75	3.43	3.45	0.30	1.33	0.14	0.60	0.55	0.25
Relationship Management	3.98	3.00	3.47	3.46	0.24	1.15	0.06	0.44	0.41	0.21
Overall EQ	3.50	1.90	2.80	2.83	0.35	1.25	0.11	0.62	0.58	0.27

Three different analyses were run to evaluate the impact of personality traits and variance of personality traits within a team on the team's performance. In order to do this, different quartiles were computed for each trait and trait variance, based on how high or low they were. The top (1st) quartile consisted of teams with the highest score for a trait or its variance, while the bottom (4th) quartile consisted of teams with the lowest traits. Following this, the project scores of teams in different quartiles were compared against each other for each personality trait. This is a key point of departure from the study conducted by Shalwani *et al.* (2018), where the quartiles were determined based on team performance scores and the team performance scores were compared. The approach used in this study, on the other hand, makes it easy to highlight the difference in performance of teams with high versus low scores for a trait.

Firstly, the project scores of teams with personality traits and variances in the first quartile were compared to the rest of the teams using a Mann-Whitney *U* test (Table 2). At $\alpha = 0.05$, the median performance of teams was significantly better if their extraversion was in the top quartile ($U = 211, p = 0.009$) and their altruism was not in the top quartile ($U = 231.5, p = 0.022$).

Table 2

Comparison of teams with traits in the top (1st) quartile versus the rest.

Personality Trait	Overall Trait					Variance of Trait Within Team				
	Teams in 1 st Quartile		Remaining Teams			Teams in 1 st Quartile		Remaining Teams		
	<i>n</i>	Median.	<i>n</i>	Median	Sig.	<i>N</i>	Median.	<i>n</i>	Median	Sig.
Honesty-Humility	19	89.00	42	87.07	0.755	16	86.50	45	88.00	0.517
Emotionality	16	88.00	45	87.00	0.634	16	87.50	45	87.13	0.863
Extraversion	17	90.00	44	86.11	0.009 ^a	16	87.66	45	87.13	0.768
Agreeableness	19	87.13	42	87.50	0.809	17	89.00	44	87.00	0.141 ^c
Conscientiousness	17	89.40	44	86.48	0.084 ^b	16	90.25	45	87.00	0.261
Openness to Experience	16	88.36	45	87.00	0.446	16	87.50	45	87.13	0.560
Altruism	17	83.00	44	88.36	0.022 ^a	16	88.70	45	87.00	0.538
Self-Awareness	16	88.50	45	87.00	0.812	16	86.50	45	87.13	0.743
Self-Management	16	87.00	45	88.00	0.309	18	87.48	43	87.13	0.728
Social Awareness	16	85.48	45	88.00	0.204	16	88.36	45	87.00	0.676
Relationship Management	16	84.80	45	88.00	0.179 ^d	17	85.78	44	88.00	0.670

Overall EQ	16	88.50	45	87.00	0.793	17	89.00	44	86.68	0.281
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^a Significant at $\alpha = 0.05$; ^b Significant at $\alpha = 0.10$; ^c Significant at $\alpha = 0.15$; ^d Significant at $\alpha = 0.20$

Next, the project scores of teams with personality trait scores and variances in the fourth quartile were compared to the rest of the teams (Table 3). At $\alpha = 0.05$, the median performance of teams was significantly better if their overall agreeableness score was not in the 4th quartile ($U = 163.5, p = 0.001$). Finally, the project scores of teams with personality trait scores and variances in the 1st quartile were compared to those in the 4th quartile (Table 4). At $\alpha = 0.05$, the median performance of teams was significantly better if their overall agreeableness score was in the 1st quartile ($U = 81.5, p = 0.011$).

Table 3

Comparison of teams with traits in the bottom (4th) quartile versus the rest.

Personality Trait	Overall Trait					Variance of Trait Within Team				
	Teams in 4 th Quartile		Remaining Teams			Teams in 4 th Quartile		Remaining Teams		
	<i>n</i>	Median.	<i>n</i>	Median	Sig.	<i>n</i>	Median.	<i>n</i>	Median	Sig.
Honesty-Humility	17	87.00	44	88.86	0.380	16	89.88	45	87.00	0.577
Emotionality	16	86.80	45	88.00	0.588	16	87.00	45	88.00	0.755
Extraversion	16	86.80	45	88.00	0.317	17	86.23	44	88.36	0.161 ^d
Agreeableness	17	81.20	44	88.86	0.001 ^a	16	83.04	45	88.00	0.054 ^b
Conscientiousness	17	90.50	44	86.68	0.171 ^d	16	87.18	45	87.13	0.974
Openness to Experience	16	86.30	45	88.00	0.583	16	87.07	45	88.00	0.544
Altruism	18	88.50	43	87.00	0.837	17	86.35	44	88.50	0.096 ^b
Self-Awareness	17	85.78	44	88.36	0.489	16	87.50	45	87.13	0.825
Self-Management	16	91.13	45	86.60	0.093 ^b	16	87.00	45	88.00	0.617
Social Awareness	18	89.20	43	86.60	0.251	16	89.50	45	87.00	0.301
Relationship Management	17	91.75	44	87.00	0.148 ^c	16	87.00	45	88.00	0.517
Overall EQ	19	88.73	42	87.00	0.137 ^c	16	89.00	45	87.00	0.422

^a Significant at $\alpha = 0.05$; ^b Significant at $\alpha = 0.10$; ^c Significant at $\alpha = 0.15$; ^d Significant at $\alpha = 0.20$

Table 4

Comparison of teams with traits in the top (1st) quartile versus the bottom (4th) quartile.

Personality Trait	Overall Trait					Variance of Trait Within Team				
	Teams in 1 st Quartile		Teams in 4 th Quartile			Teams in 1 st Quartile		Teams in 4 th Quartile		
	<i>n</i>	Median.	<i>n</i>	Median	Sig.	<i>n</i>	Median.	<i>n</i>	Median	Sig.
Honesty-Humility	17	89.00	19	87.00	0.601	16	86.50	16	89.88	0.546
Emotionality	16	88.00	16	86.80	0.521	16	87.50	16	87.00	1.000
Extraversion	16	90.00	17	86.80	0.054 ^b	17	87.66	16	86.23	0.368
Agreeableness	17	87.13	19	81.20	0.011 ^a	16	89.00	17	83.04	0.054 ^b
Conscientiousness	17	89.40	17	90.50	0.890	16	90.25	16	87.18	0.534
Openness to Experience	16	88.36	16	86.30	0.428	16	87.50	16	87.07	0.474
Altruism	18	83.00	17	88.50	0.156 ^d	17	88.70	16	86.35	0.165 ^d
Self-Awareness	17	88.50	16	85.78	0.732	16	86.50	16	87.50	0.970
Self-Management	16	87.00	16	91.13	0.073 ^b	16	87.48	18	87.00	0.617
Social Awareness	18	85.48	16	89.20	0.120 ^c	16	88.36	16	89.50	0.651

Relationship Management	17	84.80	16	91.75	0.093 ^b	16	85.78	17	87.00	0.928
Overall EQ	19	88.50	16	88.73	0.297	16	89.00	17	89.00	0.957

^a Significant at $\alpha = 0.05$; ^b Significant at $\alpha = 0.10$; ^c Significant at $\alpha = 0.15$; ^d Significant at $\alpha = 0.20$

Following this, a stepwise multiple regression was conducted in order to derive a predictive model for team performance. The overall personality scores for all twelve traits being studied and the number of members in a team were entered as the predictor variables, and project score as the outcome variable. The linear combination of overall agreeableness, self-management, and relationship management scores, and the variance of agreeableness within a team significantly predicted team performance, $F(4, 56) = 2.537, p = 0.049$. The sample multiple correlation coefficient was 0.392, indicating that 15.3% of the variability in team performance (*r-square*) was predicted by the independent variables. Standardized regression coefficients of the individual predictors indicated that high overall agreeableness ($B = 8.804, p = 0.016$) significantly predicted high team performance at $\alpha = 0.05$. However, relationship management ($B = 2.023, p = 0.822$), self-management ($B = -6.43, p = .331$), and variance of agreeableness ($B = 7.750, p = 0.130$) within the team were not significant predictors at $\alpha = 0.05$. Squared semi-partial correlations indicated that overall agreeableness explained the most variance in team performance ($sr^2 = 0.0938$), followed by variance in agreeableness ($sr^2 = 0.0357$), overall self-management ($sr^2 = .0146$), and overall relationship management ($sr^2 = 0.0008$). Thus, the predictive model for team performance is:

$$\text{Team Performance} = \text{Agreeableness} * 8.8 + \text{Variance in Agreeableness} * 7.75 - \text{Self-Management} * 6.43 + \text{Relationship Management} * 2.02 + 73.04$$

Discussion

The Mann-Whitney *U* tests of the data revealed the performance of teams significantly differed for three personality traits at $\alpha = 0.05$. This study is a methodological extension of a previous study conducted by Shalwani *et al.* (2018), which found Altruism and Relationship Management to be significantly different for high performing teams and low performing teams. However, these traits were not found to be significant at $\alpha = 0.05$ in the present study, and hence a comparison cannot be made as to the findings. This study found that teams with high extraversion, high agreeableness and low altruism tended to perform better. This means that teams that have members who are highly confident and compromising, yet not soft-hearted tend to perform better than others.

While only the results significant at $\alpha = 0.05$ are described in the previous section, difference in team performance at higher levels of significances have been indicated in Tables 2, 3, and 4. In HEXACO PI-R, team performance related to extraversion, agreeableness, and altruism were found to be significant in all three iterations of the tests, albeit at varying levels of significance. This points to the considerable impact these traits may have on team performance. On the other hand, high or low levels of Honesty-Humility, Emotionality, and Openness to Experience did not significantly impact the performance of teams.

Among the five traits in Emotional Intelligence Appraisal, Relationship management is the only trait that was found to be significant in all three tests. However, all traits were significant in at least one of the tests. An interesting finding related to the difference in performance associated with Emotional Intelligence traits is that teams with lower levels of each trait tended to perform better than those who did not. In other words, teams with students who had lower abilities to discern feelings and others and self, and use that information to guide their thinking and behavior tended to perform better than others.

A predictive model for team performance obtained through stepwise regression included the variance of agreeableness within the team, team agreeableness, self-management, and relationship management as predictors.

Conclusion

Although research supports the use of teams as an effective pedagogical tool for students, teamwork is often a source of tension among students primarily due to incompatibility among members. Instructors also find it difficult

to create optimized student teams. This research looked at the impact of personality on the performance of 60 student teams in a Construction Management course. Analysis of the data revealed that teams with higher extraversion, and agreeableness, and lower altruism tended to perform better. While the findings were not aligned with other earlier findings (Shalwani *et al.*, 2018), this could be potentially attributed to the difference in exclusion criteria in the two studies. The sample used for this study only included students enrolled in a single course across multiple semesters, unlike the previous study which had included students enrolled in multiple courses at three different universities across multiple semesters. The limitation was imposed in the interest of maintaining consistency, since the course used in this study administered a group project in a consistent format every semester. This may imply that the predictors of team performance vary by context. Therefore, it may be necessary and worthwhile for instructors to collect human dimension information from students for a few semesters and develop predictive models for courses of varying formats.

For future research, the researchers suggest replicating the study using a larger sample to ensure that the findings are reliable. While this study considered teams of students in a single course, the findings need to be replicated in other contexts as well to ensure generalizability of the results. In addition, the predictive model obtained by stepwise regression needs to be confirmed using simultaneous regression in the future. Further, it would be interesting to explore whether the demographic composition of teams had any impact on their performance, and control for them in future studies.

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