Proceedings: International Conference on Teaching and Learning, Language, Literature & Linguistic (ICT4L)
30-31 October 2017. Kuala Lumpur, Malaysia

Personality Test Effect on Team Selection and Students' Performance

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***Abstract*—** This paper presents the finding on students'performance in an engineering design unit. The unit is project based unit where the students form teams of five to six students to work on different tasks as assignments. Two team formation procedures are discussed in this work and their effects on students' performance. In an engineering design unit, the team assignments weigh 35% while individual assessments weigh 65%. The team selection was conducted in two different manners. In the first semesters 2016, about 90% of the teams were formed using Belbin personality test while about 10% were formed by just bringing a set of students that joined the class at same time together to form a team. In the second semester of 2016, the personality test was employed for the formation of the whole teams for the unit. In the third semester, first semester 2017, the students were given the opportunity to select their own teams. A comparison of the performance of the students from the different teams was made considering the performances of the teams formed using personality test and the teams formed without personality tests. The work presented here are the findings of three semesters investigation where in two semesters, Belbin personality test was used to form over 95% of the teams while in the third semester, the students were allowed to select their team members. It was observed that the results varied in two different team selection processes. The use of personality test in the team selection was observed to give students better opportunity to tap into the strengths of their peers, learn from each other and more importantly develop team-working experience. It was observed that the teams formed using Belbin test closes up the gap in their marks as assignment progresses while teams where students selected their team mates where characterized of truancy, late submission of assignments and in some cases traces of plagiarism. Grade improvement was consistent among the students who were in Semester 1 and Semester 2, 2016 considering the Individual Assignment, Team Assignments and the Design Evaluation Report.

Keywords — Personality Test, Team Work, Performance

I. INTRODUCTION

IN a team based project which requires great deal of cooperation, different skills and personalities are required not mainly based on intelligence but qualities, skills and drives. It has been reported that for the success of a project, a team needs to be cooperative, work closely smoothly and efficiently, resolve issues amicably through constructive debate (Karn et al. 2007). In a team work, individual personality has influence on the success of a project and the performance of working teams (Bass and Dunteman 1963). To solve the problems associated with the above challenges of project success and team performance, Belbin (2011) showed some approaches of personalizing individuals based on roles which might be needed for the success of a project and smooth running of a team. The Belbin personality procedure reflects that five criteria must be fulfilled in the construction of an effective team. The criteria include: (1) Substantive contribution of each member through functional role to achieving the objectives of the team's project; (2) there should be optimal balance in the functional and team roles as needed in the project; (3) Proper recognition of the individual roles and adjustment to the relative strengths of the team members; (4) The team members must have personality and mental abilities for some team roles as may be demanded by the project tasks; and (5) balance of team roles to ensure efficient team work. The team roles and the personalities have great impact on the success and learning ability of the team members in a project. The use of personality test in academia has been reported to contribute in students' development (Broucek and Randell 1996, Dulewicz 1995, Fisher, Hunter, and Macrosson 1998).

The development of students to meet the requirements of the industry requires training in the institution to incorporate real-world skills and competencies. This point has been supported by various researchers such as Denayer et al. (2003), Mills and Treagust (2003), Schachterle and Vinther (1996), Monaghan et al. (2015), etc. in the area of software engineering. To form a productive team might be very complex when effective performance is required but the effectiveness of a team in comparison to individual is far more complex than may be perceived (Monaghan et al. 2015) but from the industrial point of view it is a necessity. Thus, to achieve the needful of teamwork among students, team development with characteristics and practices that enhance higher levels of performance should be encouraged.

II. METHOD OF INVESTIGATION

The study of the effect of personality test on team formation and students' performance in an engineering design unit was conducted based on observation and review of three semesters performance of students in the unit. The semesters that were employed in the study ran through academic year 2016 and first semester of 2017 academic session which concluded in June 2017 culminating to 3 semesters.

a. Team Formation Process

In the first Semester of 2016 academic session, a total of 182 students took the unit where 54 teams were formed and

out of the 54 teams, 48 teams (representing 90% of the teams formed) were formed using Belbin personality test while six teams were formed by grouping a set of students that joined the class. This was because some students enrolled late for the unit. On the second semester, a total of 265 students participated in the unit with a total of 84 teams formed which all the students were assigned in to teams based on their personality deduced from the Belbin personality test conducted on the students in the first two classes. The personality test sample used for the team formation is presented in APPENDIX 1. In the third semester which is the first semester in 2017 academic year that ran from March 2017 to June 2017, 163 students offered the unit with a total of 50 teams formed. The team formation was a unanimous decision by the students to select their team mates based on their preference. The students were allowed to select their team mates.

After team formation, each team will be assign a project that they will work on for the rest of the semester and all the assignment the students will report will be based on their project topic.

b. Assignment Matrix

The assignment for this unit has individual and group submissions. The individual submission contributes 65% of the assessment while 35% are contributed by the team submission. In the individual assignment assessment, Table 1 displays the analysis as was found to contribute to learning and teaching.

TABLE 1:
INDIVIDUAL ASSIGNMENT ANALYSIS

Assignments	*Assignment Task*	*Weightage (%)*	*Remarks*
I	Referencing task	5	Considered in this study
II	Weekly Progress Report	15	Not relevant to this study
III	Design Evaluation	35	Considered in this study
IV	Peer Evaluation	10	Not relevant to this study

The referencing task assignment is due in the end of the second week of the semester. The design evaluation task which is the individual team member' solutions to the team's project assessed against the team agreed design specification and requirements is submitted at the end of lecture week 6. Prior to the submission of Individual Assignment III, a team Assignment I presented in Table 2 which borders on identification of stakeholders, design requirements, specifications and constraints is submitted at the end of study week 4.

TABLE 2:
TEAM ASSIGNMENT ANALYSIS

Assignments	*Assignment Task*	*Weightage (%)*	*Remarks*
I	Stakeholder Report	10	Considered in this study
II	Final Design Report	15	Considered in this study
III	Final Design Business Pitch	10	Not relevant to this study

The final design is based on the analysis of the individual designs presented by each team member which best satisfies the design specification and requirements of the stakeholders. The students are awarded same grade for any team assignment thus the major focus of this study will be on the individual assignments. It is important to note that the success of Assignment III of the Individual Assessment depends on the team work conducted in assignment I of the team submission.

c. Result Review Process

The results of the students were reviewed considering the trend of performance with respect to the different semesters and the teams. The review focused on total performance, individual performance and team performance.

III. FINDINGS ON THE RESULTS REVIEW

a. Final Grade Analysis in comparison to Assignment I – Individual Assignment

The results of the reviews are presented to show the trend of performance of the whole class. It was observed that for the teams formed using Belbin Personality Test, the students work harder from the beginning of the semester and continued to improve as the semester proceeds. In Semester 1, 2016, a comparison of the first assignment evaluated to 100% and the final grade evaluated at 100% showed that the students performed reasonably well from the beginning of the semester as shown in Fig. 1. It was observed from the review that the students that scored low in Assignment I were students from the team formed without consideration on personality.

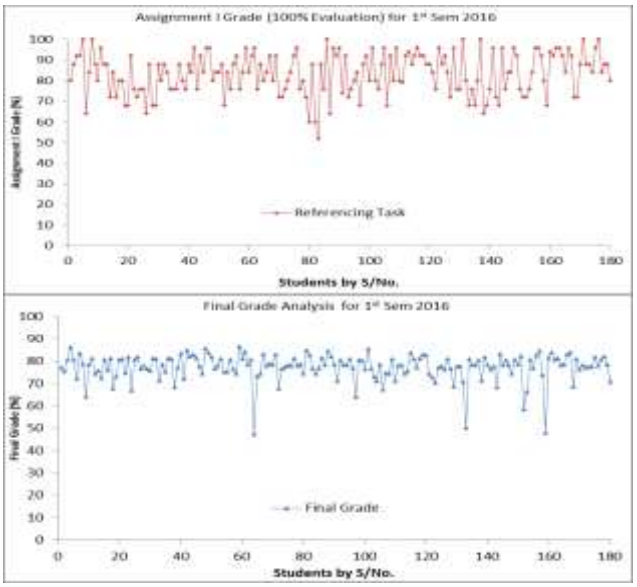

Fig. 1 Semester 1, 2016 Final Grade Analysis in Comparison to Assignment I Grade

Similarly in Semester 2, 2016, a better performance was observed when the whole teams were formed using Belbin Personality Test when Final grade was compared to Assignment I as shown in Fig. 2. The result showed clearly that some students were weaker than others which later closed up as will be discussed in the section where Assignment I was compared with Assignment III.

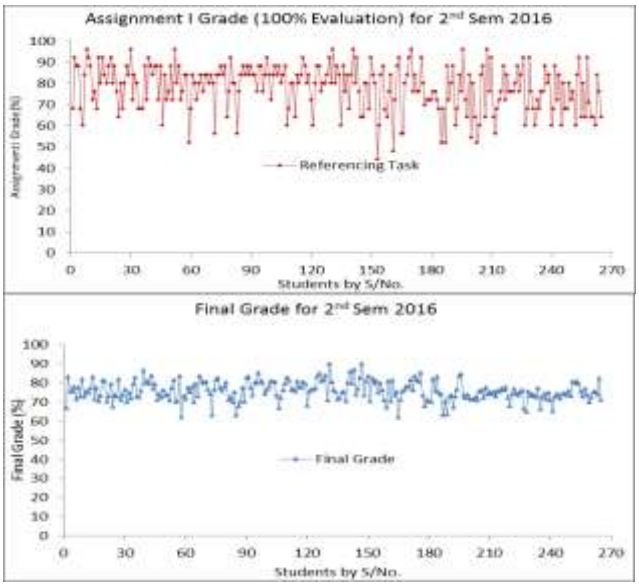

Fig. 2 Semester 2, 2016 Final Grade Analysis in Comparison to Assignment I Grade

In Semester 1, 2017, there was a high variation in the first assignment as can be seen in Fig. 3 where the final grade was compared to the grades obtained by students in the First Assignment. The results showed that there was low focus in the teams at the beginning of the semester which is attributed to the fact that some of the students were banking on their friend. This was proved by the number of plagiarism cases recorded in this set of students. 17 students in this set of students were caught on plagiarism which was linked to their team mates but not from internet sources in the first assignment.

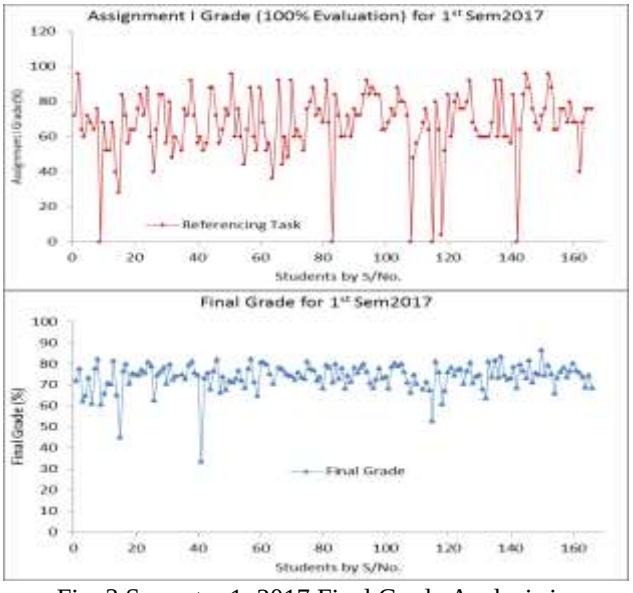

Fig. 3 Semester 1, 2017 Final Grade Analysis in Comparison to Assignment I Grade

b. Final Grade Analysis in comparison to Assignment III – Individual Assignment

Assignment III has stronger correlation to the final grade because of the weight of 35% which it carries in this unit. A study on the performances of the different sects of students are presented in Fig. 4, Fig. 5 and Fig. 6 for Semester 1 2016, Semester 2, 2016 and Semester 1, 2017 respectively.

The results showed in Fig. 4 and Fig. 5 that the students' performance were much based on their individual performance as the grades in their Design Evaluation Assignment (Assignment III) was in strong alignment with the final grade. In Fig. 5, when compared to Fig. 2, it can be seen that some of the weak students improved in their performance and was found to be within the percentage range of the team performance.

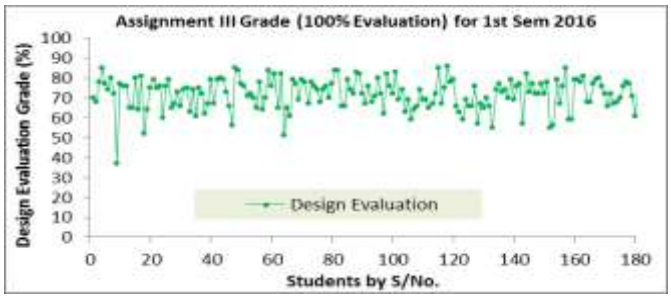

Fig. 4 Semester 1, 2016 Assignment III Grade

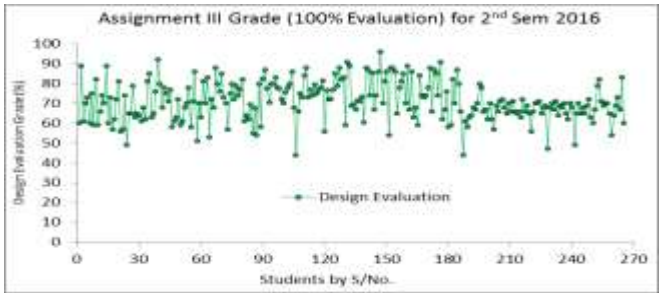

Fig. 5 Semester 2, 2016 Assignment III Grade

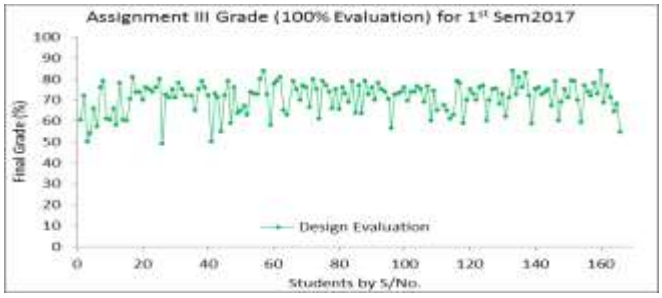

Fig. 6 Semester 1, 2017 Assignment IIII Grade

c. Assignment I Analysis in comparison to Assignment III – Individual Assignment

A clear improvement of the students' performance can be found on the comparison of the percentage performance in the first and third assignment in the unit. The third individual assignment as presented in Table 1 has strong link to Individual Assignment I and Team Assignment I. The Results comparison for Semester 1, 2016 can be made from the data of Fig. 1 and Fig. 4 with respect to the individual assignment I and the Individual Assignment III. Similar analysis for Semester 2, 2016 can be made in reference to Fig. 2 and Fig. 5 for individual assignment I and the Individual Assignment III. For these two semesters, there was closer trend of performance improvement as compared to the results obtained for Semester 1, 2017 as shown in Fig. 3 and Fig. 6.

d. Team Assignment I Analysis in comparison to Individual Assignment III

When the performance is the individual Assignment III which is design evaluation was compared with the results from the team Assignment I which is the stakeholders report, it was observed that there is higher level of consistency in teamwork in Semester 1, 2016 and Semester 2, 2016 as compared to Semester 1, 2017 as shown in Fig. 7, Fig. 8 and Fig. 9 respectively. The result of the review for Semester 2, 2016 showed stronger affirmative relationship between the design evaluation results and the results of the stakeholders' report as can be seen in Fig. 8.

Fig. 7 Semester 1, 2016 Team Assignment I Grade

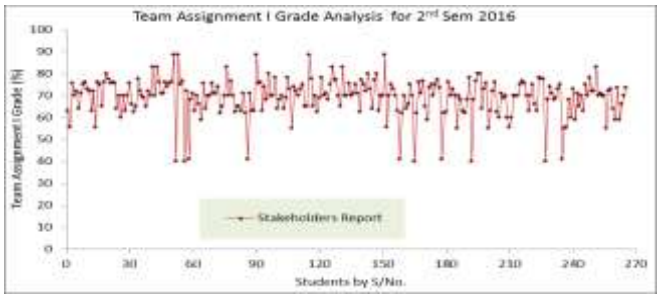

Fig. 8 Semester 2, 2016 Team Assignment I Grade

Fig. 9 showed that the students were so much self-dependent and did not work closely as a team. This might be one of the reasons why there was high number of plagiarism cases in the Semester 1, 2017 for Individual Assignment III. In this set, 30 students were found to have copied each other among their team and had high reported cases of truancy among teammates.

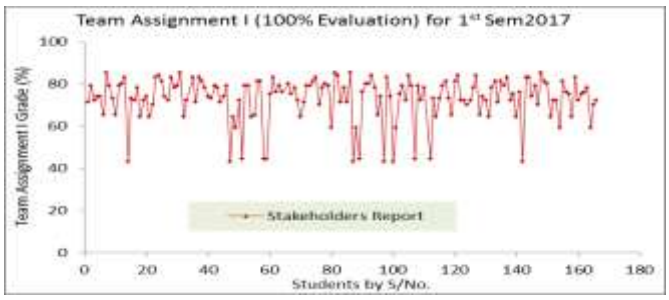

Fig. 9 Semester 1, 2017 Team Assignment I Analysis in Comparison to Assignment IIII Grade.

IV. CONCLUSIONS

The study showed that a proper selection of team for project based unit is very important in both students' development and taking responsibility. The investigation showed that students who selected their teammates by themselves have higher tendency of plagiarizing each other. The productivity of the team was also found to be stronger when the students were selected based on personality which reflected very clearly in the consistency of performance improvement among the students that offered the unit in Semester 2, 2016. The team that was formed by students on their own showed higher individual effort in the Assignment III where the students considered most important to their success in the unit but showed low performance in Individual Assignment I and Team Assignment I which the foundation were basically for Individual Assignment III. The lack of good team work and high level of truancy which was found in the reports of Team Assignment I where only few students contributed to the Team Assignment I reflected on the high number of plagiarism cases reported in Semester 1, 2017.

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APPENDIX 1

Belbin's team role questionnaire

For a detailed understanding of this approach to work groups and teams consult Belbin (1981), Belbin (1993), Belbin (2012) and Belbin (2011)

Instructions

For each section, distribute a total of ten points between the sentences to indicate what best describes your personal behavior in a team situation. For example you might give (a) 1; (b) 1; (c)); (d) 1; (e) 0; (f) 0; (g) 1; (h) 4; (i) 2 which totals 10 points. In extreme cases you may evenly distribute 1 point to each sentence or allocate all 10 to only one sentence. Enter the points alongside each sentence in the space provided. Once you have answered all seven questions, transfer the amount you have allocated to each letter to the corresponding letter in the grid on the last page. Then, tally your score for each column. Your highest scores indicate your team role strengths and/or preferences.

I. What I believe I can contribute to a team:

(a) I think I can quickly see and take advantage of opportunities.
(b) I can work well with a very wide range of people.
(c) I can usually sense what is realistic and likely to work.
(d) My capacity to follow through has much to do with my personal effectiveness.
(e) My ability rests on being able to draw people out whenever I detect they have something of value to contribute to group activities.
(f) My technical knowledge and experience are usually my major assets.
(g) I can offer a reasoned case for alternative courses of action without introducing bias or prejudice.
(h) Producing ideas is one of my natural assets.
(i) I am ready to face temporary unpopularity if it leads to worthwhile results in the end.

Total 10

II. If I have a possible shortcoming in teamwork it could be that:

(a) I am not at ease unless meetings are well structured and controlled and generally well conducted.
(b) My objective outlook makes it difficult for me to join in readily and enthusiastically with colleagues.
(c) I find it difficult to lead from the front, perhaps because I am over-responsive to group atmosphere.
(d) I am apt to get too caught up in ideas that occur to me and so lose track of what is happening.
(e) My colleagues tend to see me as worrying unnecessarily over detail and the possibly that things may go wrong.
(f) I am sometimes seen as forceful and authoritarian if there is a need to get something done.
(g) I am inclined to be too generous towards others who have a valid viewpoint that has not been given a proper airing.
(h) I am reluctant to contribute, unless the subject being discussed deals with an area I know well.
(i) I have a tendency to talk too much once the group gets on to new ideas.

Total 10

III. When involved in a project with other people:

(a) I can be counted on to contribute something original.
(b) My general vigilance prevents careless mistakes and omissions being made.
(c) I have an aptitude for influencing people without pressuring them.
(d) I am keen to look for the latest in new ideas and developments.
(e) I try to maintain my sense of professionalism.
(f) I believe that my capacity for judgments can help to bring about the right decisions.
(g) I am always ready to back a good suggestion in the common interest.
(h) I am ready to press for action to make sure that the meeting does not waste time or lose sight of the main objective.
(i) I can be relied upon to see that all essential work is organized.

Total 10

IV. My characteristic approach to group work is that:

(a) I have a quiet interest in getting to know colleagues better.
(b) While I am interested in all views, I have no hesitation in making up my mind once a decision has to be made.
(c) I am not reluctant to challenge the views of others or to hold a minority view myself.
(d) I think I have a talent for making things work once a plan has to be put into operation.
(e) I have a tendency to avoid the obvious and come out with the unexpected.
(f) I am ready to make use of contacts outside of the group itself.
(g) I bring a touch of perfectionism to any job I undertake.
(h) I can usually find a line of argument to refute unsound propositions.
(i) I contribute where I know what I'm talking about.

Total 10

V. I gain satisfaction in a job because:

(a) I enjoy analyzing situations and weighing up all the possible choices.
(b) I feel that I am using my special qualifications and training to advantage.
(c) I like to find a field that stretches my imagination.
(d) I feel in my element when I can give a task my full attention.
(e) I am interested in finding practical solutions to problems.
(f) I like to feel I am fostering good working relationships.
(g) I can meet people who may have something new to offer.
(h) I can get people to agree on a necessary course of action.
(i) I can have a strong influence on decision.

Total 10

VI. If I am suddenly given a difficult task with limited time and unfamiliar people:

(a) I tend to read up as much as I conveniently can on the subject.
(b) I would retain a steadiness of purpose in spite of the pressures.
(c) I would open up discussions with a view to stimulating new thoughts and getting something moving.
(d) I believe that I would keep cool and maintain my capacity to think straight.
(e) I would find some way of reducing the size of the task by establishing what different individuals might best contribute.
(f) I would feel like retiring to a corner to devise a way out of the impasse before developing a line.
(g) I would be prepared to take a positive lead if I felt the group was making no progress.
(h) My natural sense of urgency would help ensure that we did not fall behind schedule.
(i) I would be ready to work with the person who showed the most positive approach.

Total 10

VII. With reference to the problems to which I am subject in working in groups:

(a) I am apt to show my impatience with those who are obstructing progress.
(b) I hesitate to get my points across when I run up against real opposition.
(c) I am inclined to feel I am wasting my time and would do better on my own.
(d) I am conscious of demanding from others the things I cannot do myself.
(e) I tend to get bored rather easily and rely on one or two stimulating members to spark me off.
(f) My desire to ensure that work is properly done can hold up proceedings.
(g) Others may criticize me for being too analytical and insufficiently intuitive.
(h) I find it difficult to get started unless the goals are clear.
(i) I am sometimes poor at explaining and clarifying complex points that occur to me.

Total 10

Score the questionnaire by transferring your scores into. For example if you scored (a) 4 in part I then you need to enter 4 under the RI column next to the (a). Once you have entered all scores sum up the nine columns. Your highest scores indicate your team role styles and/or preferences.

TABLE 1:
BELBIN PERSONALITY TEST SUMMATION FOR TEAM FORMATION

Part	IM	CO	SH	PL	RI	ME	TW	CF	SP	Total
I	c	e	i	h	a	g	b	d	f	
II	a	g	f	d	i	b	c	e	h	
III	i	c	h	a	d	f	g	b	e	
IV	d	b	c	e	f	h	a	g	i	
V	e	h	i	c	g	a	f	d	b	
VI	b	e	g	f	c	d	i	h	a	
VII	h	d	a	i	e	g	b	f	c	
Total										
	Impt.	Coord.	Shp.	Plt.	R/Invest.	M/Eva.	TW	Comp.	Spec.	

Legend: Impt. – Implementer; Coord. – Coordinator; Shp. – Shaper; Plt. – Planter; R/Invest. - Resource Investigator; M/Eva. – Monitor/ Evaluator; TM - Team Worker; Comp. – Completer; and Spec. - Specialist

Source of questionnaire: Huczynski and Buchanan (2001)