The reliability of team-teaching dimension for evaluating the effectiveness of team-taught engineering courses in Universiti Teknikal Malaysia Melaka

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ABSTRACT–This study is geared towards evaluating the effectiveness of team-teaching for engineering courses from the student's perspectives to gather the overall view of the implementation. Each team-teaching dimension was evaluated using Cronbach's alpha from a survey of three team-taught engineering courses in UTeM to determine their reliability to evaluate each construct namely Generation of Interest (GIM), Unified Message and Team (UMT), Learning Effectiveness (LE) and Teaching Team Characteristics (TTC). The study found that the questions asked in this survey are relevant and reliable to measure each of the dimensions that are important in team teaching implementation.

1. INTRODUCTION

Undergraduates team-teaching method has been around for years, but studies were largely limited to computer science [1], social sciences [2-4], and medicine [5,6]. The innovation of teaching practice known as team-teaching technique was proposed as early as in 1957 in elementary school with the aim to diversify learning experience. According to Money and Coughlan [1], team-teaching can broadly be associated with one of the three forms: 1) simultaneously taught content which involves two or more academic practitioners present during each session (co-teaching approach); (2) one academic practitioner being present in each session, but taking it in turns to deliver sessions between two or more people over the duration of the course (tag rotation approach); and (3) a combination these two models (hybrid approach).

One of the common forms of team- teaching method in higher education is the tag rotation approach (TRA) [1] which requires one lecturer to be present at each session and take turns to deliver sessions between two or more people over the duration of the course. This approach was observed through the implementation of several courses in UTeM.

A previous qualitative study on computer science undergraduate students using TRA revealed that there was a greater insight into a topic when the subject is team-taught [1]. The students eventually preferred individual teaching from the team-teaching method. However, they complained on content overlap, conflicting messages relating to assessment, team-teaching members were not taking ownership of their roles and responsibilities, and the perception that the teaching team failure is worse than individual lecturer's failure to deliver lectures well.

On the other hand, a large study on social science undergraduates (Marketing Principles) [2], students revealed that they liked the concept of team- teaching. To them, team-teaching can facilitate student learning through the generation of interest and exposure to the experts, but it can be a hindrance if the teaching team failed to act as a cohesive unit and work together to link learning concepts. They also argued that the most critical factor in determining the success, or a failure of team-teaching is the actual composition of the team. Those that are skilful in teaching is far more important that team comprising experts in different knowledge areas.

Teachers'/ Lecturers' perception was also varied. A study on teacher's perception towards difficulties in team-teaching between local and native English-speaking teachers in English as a Foreign Language subject revealed that the difficulties lie in three sources: team-teachers, students, and the educational system [7]. Five constraints from team-teachers point of view were identified: lack of training in team-teaching, lack of mutual understanding, conflict of teaching styles, unclear role distribution, and little time for and expertise in planning team- teaching.

Motivated by the promising results in our previous pilot study [8], this paper continues our line of research and devises the team- teaching dimension based on the concerns voiced out from previous research [1,2] that is the teaching- team should be able to generate interest, unify the lesson, work as a cohesive unit and skillful at teaching. Hence, the chosen dimensions are the generation of interest (GIM), unity of message and team (UMT), learning effectiveness (LE) and teaching team characteristics (TTC). It is hypothesized that if the teaching team can address all the concerns from previous

research [1,2], these dimensions will be rated favorably.

Thus, the main objective of this study is to evaluate the reliability of each construct that influences the team-teaching dimension based on the survey from three team-taught engineering courses.

2. METHODOLOGY

An online survey form was created to enable participants to log on and answer the questions. The survey comprises of four different dimensions, namely Generation of Interest and Motivation scale (GIM), Unified Message and Team scale (UMT), Learning Effectiveness scale (LE), and Teaching Team Characteristics scale (TTC). The GIM, UMT, and LE's scales are comprised of five Likert-Item Questions where as TTC is comprised of seven Likert-Item Questions as presented in Appendix A. The rating scale ranges from 1 to 5; 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree [9].

The participants were recruited from three team-taught engineering courses which are BMFB 3233-Material Selection, BEKC 4753- PLC & Automation and BEKU 2333-Electric Circuit 2. There was no overlap of students recruited for each subject. BMFB 3233 was taught to the students of the Bachelor of Manufacturing Engineering, BEKC 4753 was taught to the students of the Bachelor of Mechatronics Engineering and BEKU 2333 was taught to the students of the Bachelor of Electrical Engineering. In each of the courses, more than one lecturer delivered the content of the courses according to the topics stated in the respective syllabus throughout 14 weeks of the academic teaching semester.

A total of 111 from 327 students participated in this survey. This sample assured that the result of the analysis will be accurate within 7.38 percentage points at a 95% confidence level according to the calculation presented by Kadam and Bhalerao [10].

Cronbach's alpha (α) is used to measure the internal consistency of all the metrics involved, to determine how much the items on a scale are measuring the same underlying dimension. Since multiple questions (items) are grouped together to measure a single underlying construct, e.g., Questions 1-5 are to determine the generation of interest and motivation (GIM), it is important to determine the reliability of these questions to reflect GIM of the students.

3. RESULTS AND DISCUSSION

Table 1-4 present the results of reliability analysis for the four metrics in this scale. To determine Generation of Interest and Motivation (GIM), students were asked Questions 1-5 (Items GIM1-GIM5) as presented in Appendix A.

For GIM metric, the Cronbach's alpha (α) is 0.797 which indicates a high level of internal consistency [11,12]. Table 1 presents the item-total statistics for this metric. The corrected item-total correlation represents the Pearson correlation between the specific item and the sum for all other items in this metric. Correlation that is lower than 0.3 is a cause for concern because it is an indication that this item might not be measuring the same construct. Since there are no correlations that are lower than 0.3, all items are included in the scale.

The squared multiple correlation column presents the R^2 value in a multiple regression with the dependent variable as the specific item and the predictors as the other items. It is ideal for this column to have large values so that each item can explain the variation in the other items. GIM1 has a particularly low R^2 at 0.248 and should be highlighted in further analysis to determine whether it should be dropped out from the metric.

The last column, Cronbach's alpha if item is deleted represents the value of Cronbach's alpha for the GIM scale if that item is deleted from the scale. Upon inspection, all values in this column are lower than the overall Cronbach's alpha that have been determined from including all the items, which is 0.797. Even though GIM1 has a low R^2, dropping it will reduce Cronbach's alpha, where the same will be applicable to the reliability of the metric. Therefore, all items should be used to determine the GIM metric.

To determine Unified Message and Team (UMT), students were asked five questions (Item UMT1-UMT5) presented as Questions 6-10 in Appendix A. For UMT metric, the Cronbach's alpha (α) is 0.773, which indicates a high level of internal consistency. Table 2 presents the item-total statistics for this metric. Since there are no correlations lower than 0.3, all items are included in the scale.

Table 1 GIM Item-Total Statistics

Item	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's alpha if Item Deleted
GIM1	0.469	0.248	0.794
GIM2	0.619	0.467	0.745
GIM3	0.632	0.477	0.743
GIM4	0.534	0.335	0.772
GIM5	0.653	0.438	0.735

The squared multiple correlation column presents the R^2 values for all UMT items which are all moderately correlated. Further inspection in the last column, Cronbach's alpha if item is deleted observes that; it is evident that all values in this column are lower than the overall Cronbach's alpha that have been determined from including all the items which is 0.773. Therefore, all items should be used to determine the UMT metric.

Table 2 UMT Item-Total Statistics

Item	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's alpha if Item Deleted
UMT1	0.537	0.323	0.737
UMT2	0.563	0.448	0.726
UMT3	0.596	0.428	0.717
UMT4	0.472	0.457	0.755
UMT5	0.577	0.476	0.723

To determine Learning Effectiveness (LE), students were asked five questions (Item LE1-LE5) presented as Questions 11-15 in Appendix A. For LE metric, the Cronbach's alpha (α) is 0.851 which indicates a high

level of internal consistency. Table 3 presents the item-total statistics for this metric. Since there are no correlations that are lower than 0.3, all items are included in the scale.

The squared multiple correlation column presents the R^2 values for all LE items which are all moderately correlated. Further inspection in the last column observes that, Cronbach's alpha if item is deleted; it is evident that all values in this column are lower than the overall Cronbach's alpha that have been determined from including all the items which is 0.851. Therefore, all items should be used to determine the LE metric.

Table 3 LE Item-Total Statistics

Item	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's alpha if Item Deleted
LE1	0.597	0.509	0.838
LE2	0.756	0.589	0.794
LE3	0.685	0.584	0.815
LE4	0.691	0.545	0.814
LE5	0.608	0.550	0.835

In determining the Teaching Team Characteristics (TTC), students were asked seven questions (Item TTC1-TTC7) presented as Questions 16-22 in Appendix A.

For the TTC metric, Cronbach's alpha (α) is 0.866, which indicates a high level of internal consistency, and the highest in this survey. Table 4 presents the item-total statistics for this metric. Since there are no correlations that are lower than 0.3, all items are included in the scale.

Table 4 TTC Item-Total Statistics

Item	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's alpha if Item Deleted
TTC1	0.665	0.583	0.843
TTC2	0.577	0.417	0.855
TTC3	0.693	0.526	0.840
TTC4	0.629	0.533	0.848
TTC5	0.583	0.459	0.854
TTC6	0.669	0.538	0.843
TTC7	0.659	0.582	0.844

The squared multiple correlation column presents the R^2 values for all TTC items, which are all moderately correlated. Further inspection in the last column observes that, Cronbach's alpha if the item is deleted; it is evident that all values in this column are lower than the overall Cronbach's alpha that have been determined from including all the items, which is 0.866. Therefore, all items should be used to determine the TTC metric.

All the analyses showed that the questions asked in this survey are relevant and reliable to measure each of the important dimensions in team- teaching implementation.

4. CONCLUSION

The implementation of team-teaching in engineering undergraduates requires an evaluation from multiple dimensions to determine its effectiveness. Based on the results presented, all the items are reliable to reflect each dimension of team-teaching implementation which are the Generation of Interest and Motivation (GIM), Unified Message and Team (UMT), Learning Effectiveness (LE), and Teaching-Team Characteristics (TTC).

5. ACKNOWLEDGEMENT

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APPENDIX A: TEAM TEACHING SURVEY

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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No	Dimension	Rating Scale				
	GENERATION OF INTEREST AND MOTIVATION (GIM)					
1.	It's enjoyable to see a different lecturer teaching the same subject	1	2	3	4	5
2.	It's appealing to be exposed to different teaching styles	1	2	3	4	5
3.	Different teaching style helps me increase my motivation to come to class	1	2	3	4	5
4.	Different teaching styles helps hinders lack of attention because of mundane lectures	1	2	3	4	5
5.	Team-teaching lecturers seems more enthusiastic than lecturers who teach 14 weeks straight	1	2	3	4	5
	UNIFICATION OF MESSAGE AND TEAM (UMT)					
6.	The teaching team has similar expertise in teaching the course	1	2	3	4	5
7.	The teaching team always link their lecture with the previous lecture to enhance understanding	1	2	3	4	5
8.	The content of the subject seems continuous even though it was taught by multiple lecturers	1	2	3	4	5
9.	There is no overlapping content throughout the course even though it was taught by multiple lecturers	1	2	3	4	5
10.	The teaching team appears cohesive in delivering the content	1	2	3	4	5
	LEARNING EFFECTIVENESS (LE)					
11.	The different lecturers deliver the content with their personal and work experience, thus increases the varied knowledge.	1	2	3	4	5
12.	I understood the subject better because it was team-taught	1	2	3	4	5
13.	I prefer team teaching style than having only one lecturer for this subject	1	2	3	4	5
14.	I hope team teaching style is also introduced to other subjects	1	2	3	4	5
15.	Overall, I was satisfied with my learning experience	1	2	3	4	5
	TEACHING TEAM CHARACTERISTICS (TTC)					
16.	The teaching team can stimulate, direct, and pace interaction with the class	1	2	3	4	5
17.	The teaching team encourages independent thought and accepts criticism	1	2	3	4	5
18.	The teaching team uses wit and humor effectively	1	2	3	4	5
19.	The teaching team are good public speakers	1	2	3	4	5
20.	The teaching team knows whether or not the class is following the material and is sensitive to students' motivation	1	2	3	4	5
21.	The teaching team is perceived as fair, especially in their methods of evaluation	1	2	3	4	5
22.	The teaching team are seen by students as approachable and a valuable source of advice even on matters not directly related to the course	1	2	3	4	5

Rating Scale

1. Disagree 2. Agree 3. Neutral 4. Agree 5. Strongly Agree