Integrated Cumulative Grade Point Average Peer Evaluation System Using Tukey Method

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Abstract: Ministry of Higher Education Malaysian has outlined an integrated Cumulative Grade Point Average to be implemented in universities. Among attributes that being evaluated are teamwork, leadership and communication. These affective attributes can be evaluatedusing peer evaluation especially when involving a group task. However, traditional peer evaluation is non-economical and quite cumbersome. Furthermore, compiling all the manual evaluation forms can lead to the possibility of incorrect peer assessment report especially in handling outlier marks on each student. In order to solve the problem, the Tukey method is integrated in a peer assessment system to detect such bias rating among the peers to a student. It works by detecting outlier marks from the data set and point out the marks which are unusually lower or higher than most marks in the peer evaluation. A web-based application has been developed to enable peer ratingamong team members; manage feedbacks to peers; and report any anomaly of the assessment marks given by peers. The result of such integration has minimized the student's assessment mark error in representing more accurate skill achievement level in the teamwork.

Key words: iCGPA · Peer Assessment · Web-based System · Objective Based Education · Affective Domain

INTRODUCTION

Integrated Cumulative Grade Point Average (iCGPA) is a student performance analysis based on eight generic skills, which are regulated by Malaysian Qualification Framework (MQF) [1]. One ofthe soft skillsthat is assessed in the iCGPA is teamwork[2]. In the iCGPA rubrics, this skill is described as the ability to communicate effectively, exhibit leadership and teamwork skills in the academic and professional contexts [3].Teamwork involves people working collaboratively together as a team for a common goal which involves students to work actively and collaboratively on the specific tasks in a range of settings. The outcome of the project affects each student'siCGPA grade.

Maiden & Perry[4] found out that having a free-rider in the group and getting a poor grade on a group project were the main two factors that result bad performance in a group work [4]. Group members are supposed to share the workload, however, in some groups, workloads are not shared proportionally and group members do not contribute equally. In such a case, other group members need to work harder than the irresponsible peers. It is difficult for an instructor to grade each team member systematically according to their performance because the

instructor is not working in the group [5]. Furthermore, the grade would be misleading and unfair if one or several members of a group contribute so little to a group project, but the same grade given to all members of the group.

Peer evaluation is more suitable to assess affective skills of group members because the evaluators are in the same group and have a first-hand experience with the person they evaluate. Peer evaluations are usually done by usingpaper forms that need to be filled by the students about the performance of their group members. Nevertheless, self and peer-assessments consist of reciprocal assessment processes,therefore implementing paper-based peer assessmentsare cumbersome and do have several constraints [6].One of the problems is the instructor needs to spend a lot of time and effort to calculate the marks of each student.Another problem is that there might be some biased assessment done by students, where they might act unprofessionally by giving more marks to the person they like and under-marking the people they hate without considering the contribution of that person to the team.

Students tend to contribute more when they know that they are being assessed by peers. This awareness can indirectly increase the performance of the whole team. Previous studies have found that the performance level of

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a group can be increased by carrying out blind peer evaluation systems. There are indications that students' performance evaluations of their peers are affected by whether they also do self-assessment [5]. Nevertheless, many issues have been raised about the students' doubt over the honesty and effectiveness of the peer evaluation. Among the issues range from collusion, unfairness, collusion, favouritism, to personal hatred and complexity of the score calculation process [7].

Therefore, the iCGPA Peer Evaluation System using Tukey Method aims to assist instructors in generating marks where peer evaluations are required to assess students' affective domain using an online system. The marks that have been calculated by this system can be instantly used as a feedback to students in recognizing their performance in the team. As an addition, by integrating the Tukey method, the system can also alert the instructors any unusual or outlier marks received on each student. It helps the instructors to either include or exclude the biased mark from the calculation in order to minimize the score error after having some investigation or interview with the respective student.

Peer Assessment Calculation Techniques: One of the simplest algorithm in grading a student based on multiple criteria is a mean calculation. It also known as arithmetic average which use to calculate the average of numbers in a data set. The mean can be found by adding the values of the data and dividing by the total number of values. This technique was used in this project to calculate peer evaluation score for a student. Formula for mean calculation is as shown in Equation 1.

$$\mu = \frac{X_1 + X_2 + X_3 \ldots + X_N}{N} = \frac{\sum X}{N} \qquad (1)$$

where μ is the mean, X are numbers in the series and N is the amount of numbers in the series.

Tukey Method is one of the techniques that can be used to detect outlier numbers in a data set. Outlier number is any number that was unusually high or low compared to other numbers in a data set [8-9]. Tukey Method was implemented in this system to detect any bias rating from any peer evaluator. As shown in Figure 1, calculation of the outliers utilises the median, first quartile (Q_1) and third quartile (Q_3) of a series of number. Outliers are the numbers that are lower than the low fence or higher than the high fence. Equations for the low fence and high fence are $[Q_1-(1.5 \times IQR)]$ and $[Q_3+(1.5 \times IQR)]$ respectively, where IQR is the interquartile range (Q_3-Q_1).
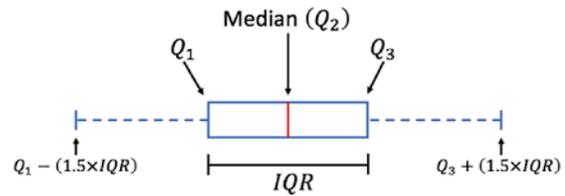

Fig. 1: Low and High Fence in Tukey Method.

Both the mean calculation and Tukey method are integrated in grading the peer assessment's scores. In this research, Tukey method is used to indicateanymarks in the data set that lies outside the normal range. These anomalies might be a sign of unjust or biased peer assessment. The instructors can later decide whether to directly use the mean of the marks, or leave out all the outliers and use the mean of the remaining numbers in the data set as the final mark of the students.

iCGPA Peer Evaluation System: In this study, iCGPA Peer Evaluation System has been developed to replace the paper-based peer evaluation form that have been used by student and teacher to evaluate a student's contribution in a team assignment. This system allows students to rate their team members' performance in a group task according to the assessmentrubric. This system also calculates the aggregated mark achieved by students and detect any irregular rating from peer evaluators. The system consists of two modules, namely: Instructor Module; and Student Module. Instructors and students need to register an account of peer evaluation system in order to use this system. Users will be given choice either to register as a student or instructor. The system administrator will then authenticate the access level of the user. Users will be guided to a personal information update page. Upon finishing the registration, users will be authorised to access the system.

Instructor Module: In the Instructor Module, instructors will be allowed to manage courses, student groups and peer evaluations. Firstly, instructors would need to create a course that can be enrolled by students. Once the course is created, instructors can ask students to register to the course and the instructors can proceed to manage student groupings and also schedule peer evaluations. Instructors will be able to edit and delete any course that they have created.

Students need to be grouped into their respective team before any peer evaluation can be handled. Figure 2 shows the screenshot of the system where instructors can manage student groupings. Instructors can create group

and assign students to any group that has been created. The list of groups that has been created for that grouping are shown at the left side of the screen. When instructors select any group, the member for that group will appear on the right side of the screen. Instructors will not be allowed to assign a student to more than one group. Instructors will have the ability to create, edit and delete any group and remove any students from any group that the students have been assigned to.
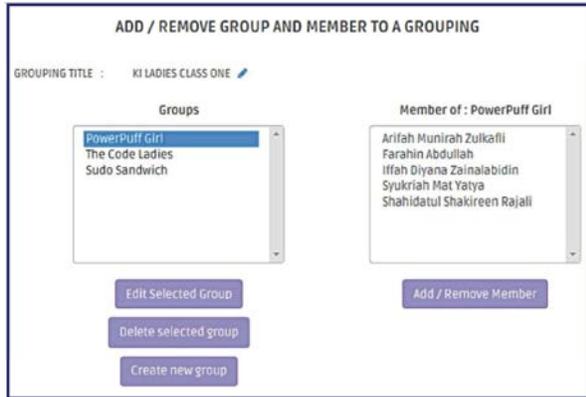

Fig. 2: Student Grouping

Once the grouping is completed, the instructor can proceed to schedule peer evaluations for the student. Figure 3 shows the peer evaluation scheduling page. All of the field must be filled up except the message field. Instructors must key in the title of the peer evaluation and set the date and time when the peer evaluation will be activated. The instructor will choose the student groups that needs to undergo the peer evaluation.

Fig. 3: Scheduling Peer Assessment

The instructor can view the peer evaluation results any time during and after the evaluation. Figure 4 shows the report that contains the information of the peer evaluation. The results of peer evaluation are arranged according to their group. Marks by evaluator is the average mark given by teammates for their contribution in team while scores are the average marks from the evaluator in percentage. The numbers that has been highlighted in red indicates that the mark given is an outlier. The instructors should be alert that the marks given might be caused by a biased assessment. The outliers are detected using Tukey method by comparing the marks with the low and high fence of the number series.
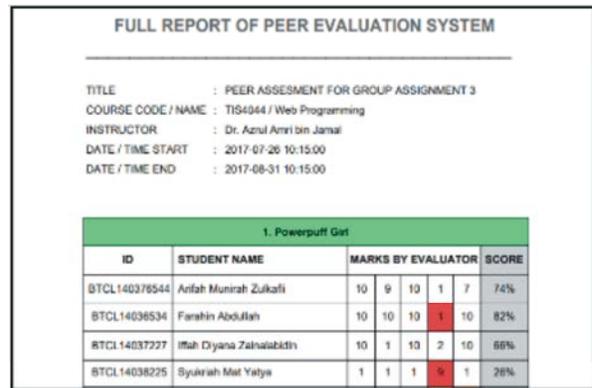

Fig. 4: Peer Evaluation Result (Instructor's View).

Student Module: In Student Module, students must enrol to course created by the instructor in order to enable any peer evaluation to be made. Figure 5 shows list of courses that are available for the student to enrol. The page will display the course information that has been created by all instructors. Students can enrol and access to any of the courses, provided that they have the enrolment key of the course. Enrol buttons are only visible on courses that has not been enrolled by the students. Once enrolled, the enrolment button will disappear.
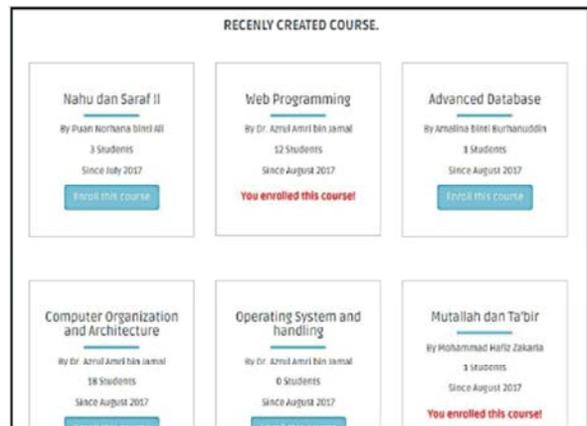

Fig. 5: List of Course Offered to Student
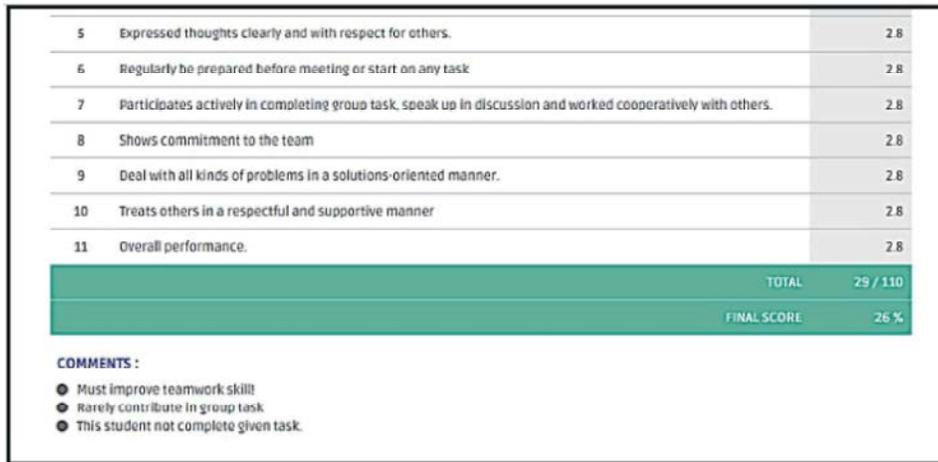
Fig. 6: Student Undergo the Peer Evaluation.

Fig. 7: Results of Peer Assessment.

Students can start the peer evaluation between the start and the end date and time of the peer evaluation. Students are required to rate their team members and themselves based on the rubric that has been set by the instructors. There will be 11 criteria for a peer evaluation session. As shown in Figure 6, students will be given a one to ten slide bar to rate their team members, with one is the lowest mark and ten is the highest. Students should click the 'next' button and rate their team members until eleventh criteria. After the eleventh criteria, the peer evaluator can leave a comment to the team members that are being evaluated. The comments can be viewed by the team members, but the evaluator will be kept anonymous.

Figure 7 shows the result of a peer evaluation. Students can view their marks that they received from that peer evaluation once the peer evaluation period ended. The score will be calculated using mean calculation which are converted into percentage. Students also can view more details of their performance rate by viewing the report. The information on the peer evaluation is placed on top of the page following by the score obtained by students based on the teamwork skill criteria. The final score in percentage are shown at the end of the page with any comment left by their teammates. Student also can print or download their report in PDF.

CONCLUSION AND FUTURE WORK

iCGPA Peer Evaluation System has been developedto replace the paper-based of peer evaluation. The system has been developed successfully to overcome problems related with peer evaluation session such as mark calculation complexity and biasedassessment. It also has additional advantages such as ease-of-use, secured data storage and reduce the paper usage.The developed system can calculate numeric score for the student instantaneously.

The system can be enhanced further by generating advice for the students based on their score for each criterion. The advice will tell the student which part of the teamwork skills that the students need to focus on in the future. K-Means clustering algorithm or weighted sum model can be used to generate the advice. Another good improvement can be carried out is by integrating this peer evaluation system with e-learning platforms such as Moodle, Canvas, or Blackboard. It will be easier and more efficient in that way because many higher education institution have already adopted some kind of e-learning platform to assist teaching and learning.

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