

**AC 2008-1997: UNDERGRADUATE ENGINEERING TEAM PROJECTS: IS THERE ANY CORRELATION BETWEEN PRESENTATION AND PARTICIPATION?**

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## Abstract

Oral presentations can be used to assess student performances in design projects. In a capstone course, students are required to complete a design project in two consecutive academic semesters. Each project generally involves more than two members. The final group report, presentation, and oral interview are the usual methods to evaluate each member's contribution to the project. Since these tools sometimes do not suffice, peer assessment questionnaires have also been suggested by researchers to evaluate each student's contribution to the project. The goal of this research was to evaluate each student's participation in a team based project from the oral presentation performance. The result will provide an additional assessment tool for an instructor to effectively evaluate each student's performance in a group. To accomplish this, team project data was collected from freshman and senior level courses from two universities' undergraduate engineering program. In this research, both, an independent evaluator and peer evaluators evaluate each student's performance during the group oral presentation. The Spearman's Rank Correlation method was used to determine whether there is a correlation between the team participation and group presentation in the project. For all group members, the result shows a strong correlation between oral presentation score and project participation grades.

## 1. Introduction

In the capstone based design projects, the student work together in teams to create solutions to design problems originating from four sources. In this study, the sources of the design projects were faculty projects, industry supported projects, projects for design competitions, and student initiated projects.<sup>1</sup> Each team consisted of three to four students. Each team had a faculty advisor. The final grade for each student depended on the oral presentation, report, and peer assessment. Peer assessment questionnaires were made and explored by educators to evaluate each student contribution to the project<sup>2</sup>. Michaelsen *et al.*<sup>2</sup> presented a peer assessment questionnaire to assess the team members' participation level in the team based group project. Sanders *et al.*<sup>3</sup> reported a statistical method of measuring the effectiveness of the interdisciplinary engineering capstone project using weekly and final oral presentation evaluations. The group project presentation is assessed by faculty and invited guests on knowledge gained, coordination, team participation, and leadership skills. Kuisma<sup>4</sup> presents portfolio assessment techniques to assess an undergraduate group project in the Physiotherapy Program. This technique involves the students themselves reflecting on and evaluating their

learning and also allows teachers to evaluate individual students' learning in group tasks. Traditionally, design reports alone have been the method by which the students' performance is judged in typical capstone design courses<sup>5</sup>. However, this limits the ability of the faculty to determine the students' interaction with their companies and also with their peers. Rubrics are generally written to insure the consistency of the assessment of the writing report. Brackin and Gibson<sup>6</sup> show how rubrics were developed for senior mechanical engineering design reports and then how they were used by three different groups: the course instructors, other departmental faculty, and outside engineering practitioners.

Thinking, sharing, and accessing works among team members is considered to be pedagogically an important lesson in this project-based design. The article of Dym *et al.*<sup>7</sup> on the role of design in the engineering curriculum made important recommendation that engineers in academia, both faculty members and administrators, should make enhanced design pedagogy their highest priority in project-based design courses. To be successful in the team project, the students must interact not only with their project sponsor but also with their team mates in order to accomplish team goals. The assessment of these important interactions and the resulting changes to the courses are one of the most important pedagogy aspects for the course supervisor in the team design courses. The desire to evaluate group member teaming skills as well as technical competence led the authors to investigate different approaches for assessing student learning. Wellington *et al.*<sup>8</sup> developed an assessment strategy to evaluate individual student performance based on group performance on both written reports and presentations. These were assessed by both industry partners and supervisors. The performance of each individual technical skill was assessed by the supervisor and peers of students. In this paper, the authors demonstrate the use of oral presentation evaluations as well as student assessments on other group members to quantify student performance both as team members and design engineers. Therefore, the objective of this research was to find an alternative assessment method by investigating whether there is any correlation between the participation of the group members and presentation skill will be investigated. Such finding will be important resource for a project based course supervisor to evaluate each student contribution correctly during the team project. The hypothesis of this study is that there may be a correlation between the participation of a given group member and the presentation skill. The scope of work in this research is: (1) develop an oral presentation and peer participation evaluation worksheet, (2) find a correlation between the participation and presentation skill from the oral presentation and a peer participation evaluation grade given by the independent evaluator and peer evaluators, and (3) find the statistical significance of the collected data.

## 2. Methodology

Spearman's Rank Correlation method is commonly used method to find the correlation between two sets of data that are independent of each other<sup>9</sup>. The objective of this statistical analysis is to determine whether there is a correlation between the participation and group presentation grades in the undergraduate team project. The whole analysis procedure is divided into two analyses based on oral presentation and peer participation evaluation data. Each member mid and final presentation was evaluated under a standard oral presentation evaluation procedure. The instruction and evaluation worksheet of the oral presentation used in this research

is shown in Figure 1 and Figure 2, respectively. Each presenter required to be evaluated in four categories during the team project oral presentation in the evaluation worksheet, namely, (1) organization, (2) technical contents, (3) presentation (4) visuals. Two sets of evaluators, namely, independent and student, evaluated each student oral presentation by giving ranks from A+ (97.5-100) to F (0 to 59.4) based on these categories during group presentation. Independent evaluator can be the supervisor of the team projects, other departmental faculty members or technically sound academic personal. Student evaluators consist of students other than the group mates. Independent and student evaluation grade of each of the presenter were averaged. The instruction and evaluation worksheet for oral presentation and the peer assessment questioner were prepared using Carr *et al.* guidelines<sup>10</sup>.

Each presenter will be evaluated in four categories.		
<b>Evaluation:</b>		
<b>(1) Organization</b> (objective stated clearly, essential terms defined, ...)		
<b>(2) Technical Content</b> (Library research, knowledge of subject, originality, ...)		
<b>(3) Presentation</b> (poise, clarity, eye contact, platform manner, ...)		
<b>(4) Visuals</b> (slides ligible, tranparences to complicated, ...)		
Scores are from A+ to F, on a scale of 100.		
97.5-100 A+	92.5-97.4 A	89.5-92.4 A-
87.5-89.4 B+	82.5-87.4 B	79.5-82.4 B-
77.5-79.4 C+	72.5-77.4 C	69.5-72.4 C-
59.5-69.4 D	0.0-59.4 F	
<b>NOTE:</b> Write your name and date in the provided space on the evaluation sheet. In the evaluation sheet mark right sign ( X ) in the ractangular box, which would evalute the skill of the presenter.		

Figure 1 Instructions for oral presentation evaluation

Each member participation level in the project was evaluated from the rest of the group members using the team peer assessment questionnaire grades. This confidential survey was conducted before final presentation. The questionnaire that is used in this research is presented in Table 1. The questionnaire consists of eight questions. Again, two sets of evaluator, namely, independent and student, evaluated each student participation level to the project by giving ranks from 1 to 5 to each category as listed in the questionnaire. In case of peer participation evaluation, independent evaluator is the supervisor of the team projects. Student evaluators consist of students other than the group mates.

Name:		Category	A	B	C	D	F
Group-1	1. Mr. X	(1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2. Mr. Y	(1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	3. Mr. Z	(1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Group-2	1. Mr. A	(1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2. Mr. B	(1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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		(3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	3. Mr. C	(1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(2)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	4. Mr. D	(1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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		(3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		(4)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 2 Evaluation worksheet

Table 1 Team peer assessment questionnaire<sup>1</sup>

Almost Always	Often	Some-times	Seldom	Almost Never	Statement	Statement Number
5	4	3	2	1	Showed initiative by doing research and analysis, took on tasks	1.
5	4	3	2	1	Prepared for and attended scheduled meetings	2.
5	4	3	2	1	Reliably fulfilled assignments and the work was of high quality	3.
5	4	3	2	1	Contributed to writing the final document of the semester (e.g., proposal, and final report)	4.
5	4	3	2	1	Contributed to preparing/making project presentation	5.
5	4	3	2	1	Kept team focused on priorities	6.
5	4	3	2	1	Listened carefully to contributions of others	7.
5	4	3	2	1	Demonstrated effective leadership on the team	8.

Variable weight was provided to the rank of the questions in the questioner due to their impact to the project performance. Peer participation final grade was evaluated by percentile weighted average method. For this, the rank of the question, X is converted to percentile system, X', as shown in Table 2. The total weight of ten was distributed to eight questions. Weight of two was provided to the fourth question, one and half weight was provided to second and fifth question and the rest of question was provided with unit weight. The following equation was used to evaluate the peer participate grade:

$$\text{Peer Participation Grade} = \sum_j \frac{1}{(N_g - 1)} \sum_{i=1}^8 \frac{w_{i,j} \times X'_{i,j}}{10} \quad (1)$$

where  $i, j$  is the number of question and student number,  $N_g$  is number of students in a group,  $w$  is the weight of a question.

Table 2 Conversion of 1-5 rank to percentile system

X	X'
1	59
2	69
3	79
4	89
5	100

Spearman's Rank Correlation method was used to find a correlation between the peer participation and oral presentation grades. According to this method, the correlation co-efficient can be found from the following equation:

$$r = \frac{n (\sum xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}} \quad (2)$$

where  $x$  are the independent or student evaluator cumulative oral presentation grades calculated by averaging the grades of four categories on the oral presentation worksheet and  $y$  are the independent or student evaluator cumulative peer participation grades calculated by averaging the grades of eight questions on the peer participation worksheet. In this research, the following correlation was sought for each project groups:

1. Independent evaluation of oral presentation vs. independent evaluation of peer participation.
2. Independent evaluation of oral presentation vs. student evaluation of peer participation.
3. Student evaluation of oral presentation vs. independent evaluation of peer participation.
4. Student evaluation of oral presentation vs. student evaluation of peer participation.
5. Independent evaluation of oral presentation vs. student evaluation of oral presentation.
6. Independent evaluation of peer participation vs. student evaluation of peer participation.

A paired t-test was conducted to compare the class professor oral presentation grades with the average of the rest of independent evaluator grade. T probability (also known as P), correlation and correlation probability between these two groups of oral presentation data sets was the output of this statistical analysis.

### 3. Data and computation techniques

A total of 96 students participated in this study. 64 of the students, working in 16 teams, were from University #1, while 32 of the students, working in 8 teams, were from University #2 (see Table 3). For each of these teams, the data collected was from the oral presentations and the peer evaluations. The oral presentations of the students from University #1 were evaluated by two faculty members, and the students listening to the presentation (i.e., the team presenting was evaluated by the rest of the class). In this study the faculty member teaching the course will be referred to as “Professor” while the other will be referred to as “Independent Evaluator.” In University #2, only one faculty members performed the evaluations of the oral presentations.

The sizes of each team are depicted in Table 4(a). This table contains the total population considered in this study. There were a few instances when the students did not submit their peer evaluation forms, this lead to incomplete data for some groups. The teams with complete information are shown in Table 4(b). Only the data for the groups with complete information were used in calculations of the correlation coefficients as will be discussed in section “Results and Discussions.”

To conduct the paired t-test between two faculty members that performed the evaluations of the presentations at University #1, the entire student population was considered. This analysis was performed using a commercial.

Table 3 Summary of the data source

	University # 1	University #2
Department	Mechanical Engineering	Freshmen Engineering
Course Number	ME4370	ENGR 196
Course Name	Engineering Design I	Introduction to Engineering
Level	Senior	Freshmen
Total Student	64	32

Table 4 Population and sample of the class (a) Total population, and (b) Sample data

Number of Group Member	Total Projects	
	Univ. # 1	Univ. # 2
3	3	2
4	10	4
5	3	2

(a)

Number of Group Member	Total Projects	
	Univ. # 1	Univ. # 2
3	4	2
4	6	2
5	2	1

(b)

## 4. Results and Discussions

Figure 3 and 4 present the correlation of the oral presentation scores versus the peer evaluations scores for University #1 and University #2, respectively. The teams consisting of five members, four members, and three members were considered separately. The analysis indicates that the group size has no significant influence on the performance of each project team. Similar results were also reported by Griffin et al.<sup>11</sup> in their research on how group size impact capstone design projects. It is observed, for University #1, that there exists a strong correlation between oral presentation performance and peer evaluation scores. A similar outcome was also observed for University #2. This result supports the hypothesis that there is a positive correlation between peer evaluation score (team participation) and oral presentation score. This is supported by both the results for seniors (University #1) and freshmen (University #2).

To investigate the issue whether there is a difference between how the student and faculty members score the oral presentation, statistical significance tests were performed. Two statistical analyses were performed to determine the statistical significance of the sample data used. First, for University # 1, a paired t-test between two faculty members' oral presentation grades was performed. The results showed a poor correlation between scores of the faculty members (see Figure 5). The entire class population at University #1 was used for this statistical analysis. The t-value of 14.056 shows that there is no statistically significant difference between the two means. A correlation value 0.223 indicates that a moderate linear correlation coefficient exist between the two groups.

## 5. Conclusion

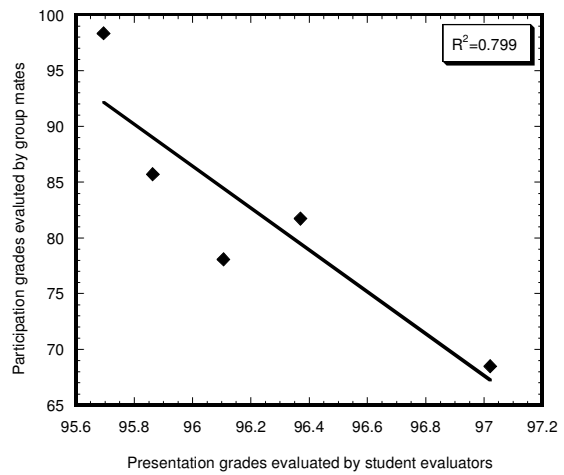
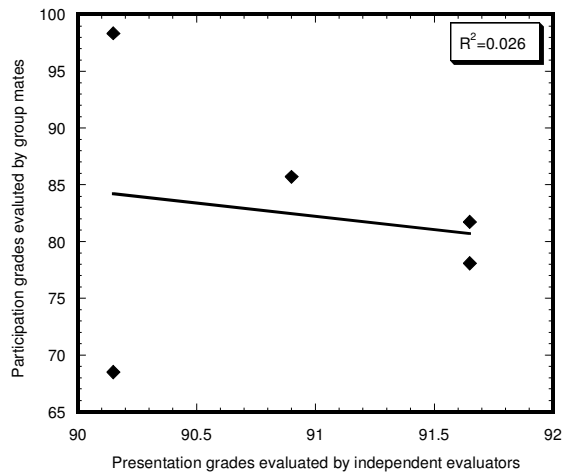
In the research the relationship between the scores of the peer assessment (team participation) and scores of the oral presentations (presentation performance) is studied. Participants in this study included senior students and freshmen students. The data presented showed that there is a strong correlation between team participation and presentation performance. The Spearman's Rank Correlation method was used in this analysis.

## 6. Bibliography

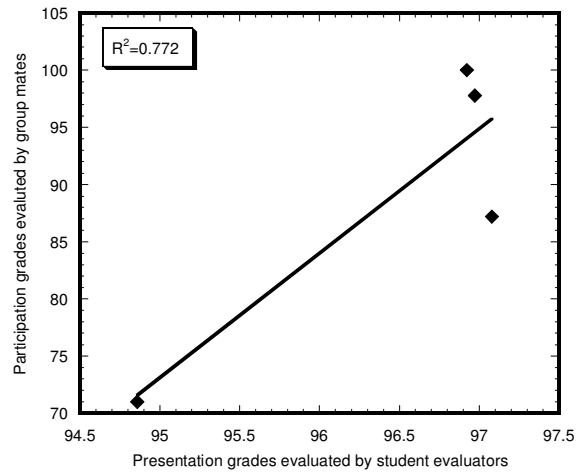
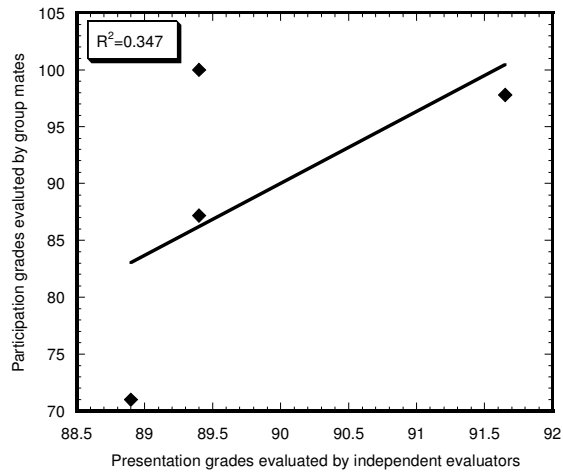
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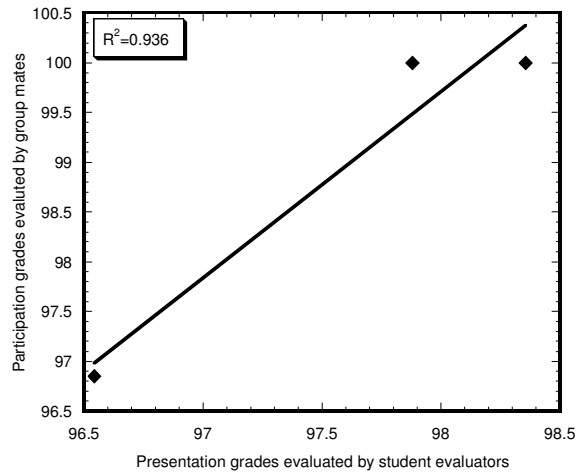
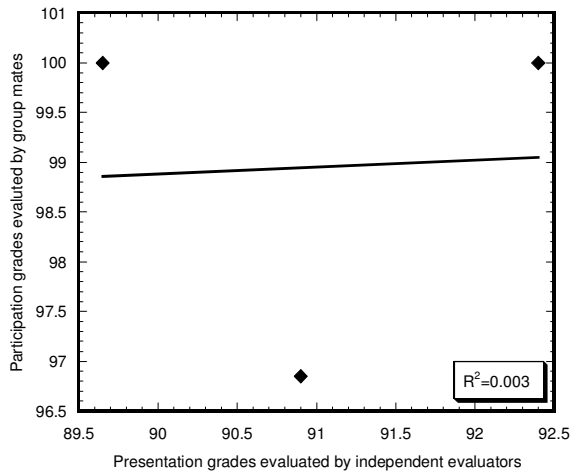
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(a) Five members group

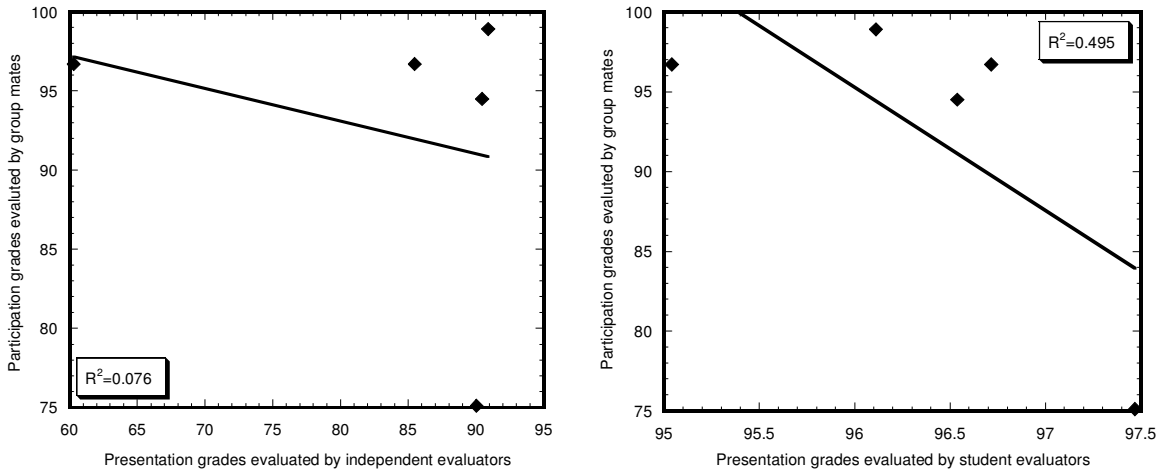


(b) Four members group

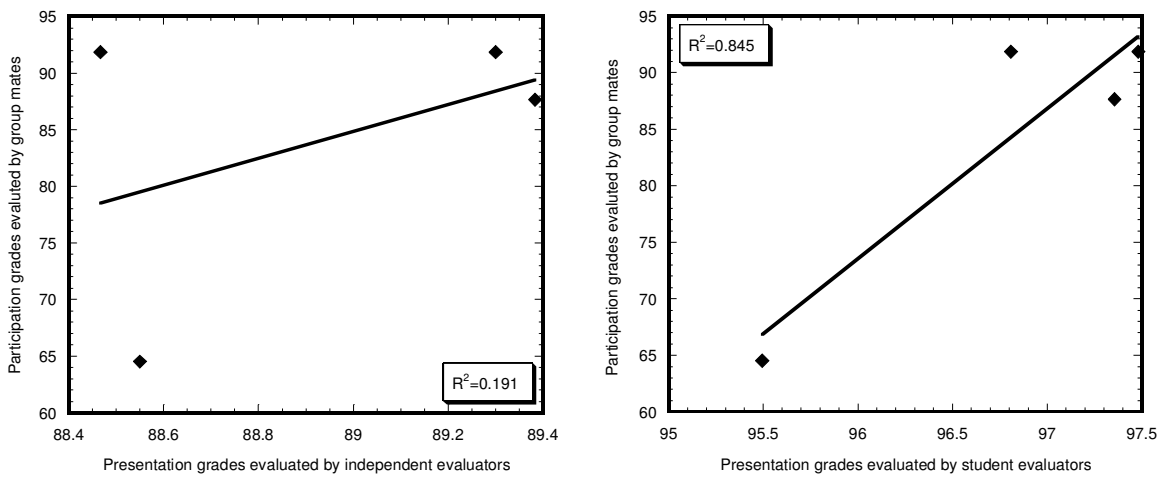


(c) Three members group

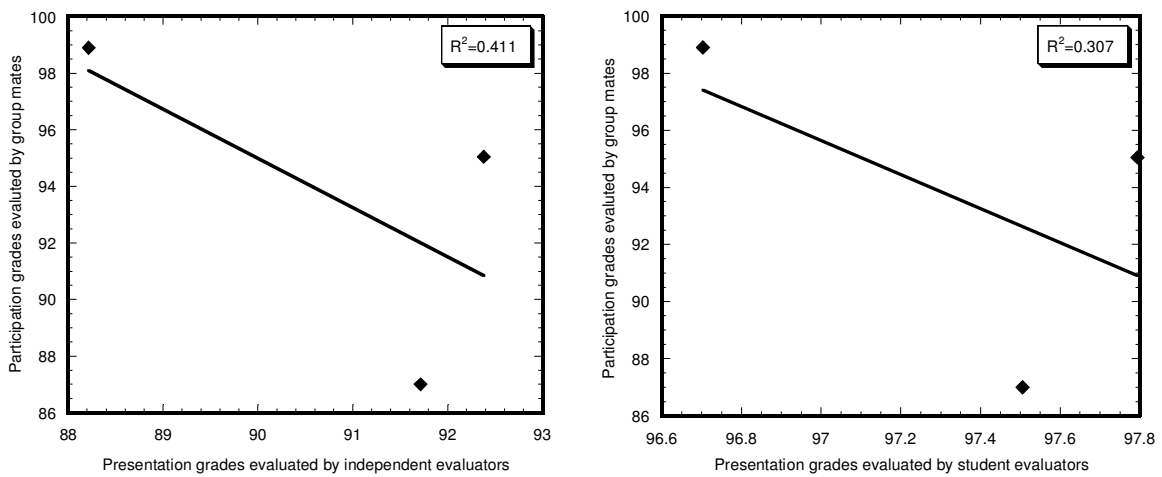
**Figure 3 Correlation of Independent and student evaluation of oral presentation with student evaluation of peer participation- University #1 results.**



(a) Five members group



(b) Four members group



(c) Three members group

**Figure 4 Correlation of Independent and student evaluation of oral presentation with student evaluation of peer participation - University #2 results.**

Student t Test for paired data  
Group 1: Professor Grade  
Group 2: Other Independent Evaluator Grade

	Group 1	Group 2
Count	212	212
Mean	92.5557	88.2193
Variance	9.47234	16.2348
Std. Dev.	3.07772	4.02925
Std. Err	0.211378	0.27673

Mean Difference	4.33632
Degrees of Freedom	211
t Value	14.056
t Probability	< .0001
Correlation	0.22299
Corr. Probability	0.00108

**Figure 5 Paired t test result**