



## Consistent Course Assessment Model

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### Mr. Jerry Cuper, Lawrence Technological University

Jerry Cuper is a professor and advisor in the Department of Engineering Technology in the College of Engineering. His education includes graduate and undergraduate degrees, and completion of a technology apprenticeship program. Mr. Cuper's career has spanned a wealth of experience in the machine shop, on the drawing board, in construction, and many years in engineering design, testing and development, management, and planning. Most of his career was with the Ford Motor Company. Mr. Cuper's last assignment was managing the Ford Technology Review Center to help implement suppliers' new technologies. He developed and led the implementation of a new supplier process to dramatically change the way supplier technologies were integrated into Ford products. This supported Ford's vision to change from being a fast follower to being a leader in technology. Mr. Cuper developed the first-production automotive application of Graphite Fiber Reinforced Plastic; this bracket was given the Materials Engineering "Award of Merit". Cuper has taught courses in engineering and business at Lawrence Tech evening programs as an adjunct instructor since 1978. He has demonstrated the ability to work extremely well with students to focus their efforts on academic achievement and long-term career goals. Mr. Cuper's passion is muscle cars. He has owned 21 Mustangs over the years, starting with the 1965 Fastback 2+2, and now has a 2013 GT glass-roof coupe.

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## 1. Abstract

In the last decade or so educational goals assessment was the center of attention in many higher education institutions. Accreditation agencies like the Higher Learning Commission (HLC) and Accreditation Board for Engineering and Technology (ABET) are among a larger spectrum of entities demanding assessment should not only be part of the educational programs management process, but it should also be part of a more comprehensive process, which is the continuous improvement.

Based on these facts, a need for developing a consistent model in the assessment at the course level is highly needed. This model should map course assessment to the program learning outcomes and ultimately to the university educational goals, because it is an important stage in the whole assessment process.

This paper is intended to present a methodology of assessing program learning outcomes through assessing the course learning objectives.

Teaching course by objectives has gained momentum in the twenty first century; it has proven beneficial to the students, instructors and the educational process at large.

We will show that the assessment of a well-defined set of course learning objectives will provide a reliable source of program learning outcomes evaluation if they are mapped properly.

The conventional course evaluation that most institutions distribute at the end of each semester does not provide indices for success or failure to achieve the educational goals or program learning outcomes. It does, however, give indications about a set of information that cannot be considered a model of assessment.

The model that we have designed and used for three semesters has two methods of assessing course learning objectives: direct and indirect.

The direct assessment is conducted by the instructor where he or she will set up the level of achievement that is designed for each objective. Then the instructor will get feedback on the level of achievement based on the tests, assignments and projects results meant to assess the level of achievement of the particular objective. This process will be an ongoing process throughout the semester where the final actual level of achievements will be compared with the desired level set by the instructor at the beginning of the semester. The negative or positive deviation from the target score of achievement per objective is then used to analyze the learning process and identify means and methods to improve or maintain the target achievement.

The indirect part is the student's contribution to the assessment model, where students will rank the achievement of the same learning objectives from their perspective.

The model will easily pinpoint if there is any inconsistency in the assessment. The results from both direct and indirect sources should provide the same picture and level of achievement within statistically accepted differences.

Any significant deviation from consistency is an indication of a serious problem in the course structure and probably methods of delivery that should be dealt with at the department level.

The paper will discuss the process of the successful writing of measurable learning objectives. We will introduce statistical analysis of results from selected course assessments.

We will demonstrate that this assessment process could lead to a continuous improvement process if it is properly integrated in the plan of improvement.

The paper will also discuss the mapping of course learning objectives to the program learning objectives and university goals.

## **2. Teaching by Measurable Objectives**

A common belief that the student's grades in different tests and assignments could be used to assess course learning objectives; this belief has been challenged and proven insufficient as a statistical indicator for course assessment.

Teaching by objectives is a delivery method that has proven efficient over the years. Department and colleges attach objectives to their curriculum, programs, and plans of work, course descriptions and syllabi. Many of these objectives are general and sometime vague because they do not express measurability of success of these objectives. Examples of these objectives are: The student will understand..., the student will be familiar with...; the student will acquire knowledge of... and so on.

These types of "course learning objectives" have three major deficiencies; the first is generality where the objective is so general that it could be used for almost any other course even from different level or knowledge area, the second is there is no indication of the skill to be acquired, and the third is that no measurement tool could be used to assess the achievement of the objectives and to compare performance of different groups.

Learning objectives for a course should be written in a way that expresses clearly the skills to be built through the course and the measurability of these skills. The objectives should clearly describe what the student will be able to do as a result of the learning experience of this course. These objectives should be lined up with other course learning objectives to support the program learning outcomes.

Once the objectives are written properly, the mastery target should be set for each objective of the course based on the importance of the objective to the course and to the program. Mastery, in our opinion, is anything above 80%, yet there are some instructors who set 75% as the target for some of their course learning objectives.

### **3. The Assessment Model**

The Assessment Model of Course Learning Objectives that we are introducing consists of two different tools; these are:

#### **3.1 Direct Assessment Tool:**

This tool is prepared by the instructor of the course. Each course in the educational program has to have several objectives that are linked to the program educational learning outcomes. The instructors set up the mastery bar for each objective using a statistical indicator which is normally a percentage. The objectives are directly tested through student's evaluation tools such as exams, projects, homework. Each instructor is to calculate the average performance of the class towards each objective and record the data.

Some of the objectives could be accessed through more than one evaluation tool or could be assessed more than once. The instructor will average the data by objective and record it. At the end of the semester, instructors will statistically summarize data in a table that shows the objectives, the link to the program learning outcomes, the target achievement per objective, and the actual achievement of the class by objective. The assessment at the program level will use data provided by instructors, tabulate them in a template that will generate statistical indicators like the deviation from the target, the overall mean performance and the standard deviations of the scores.

These statistical indicators will be analyzed by the instructor of the course to create an action plan to close the loop of the deficiency, if required, to satisfy the target for each objective. The department will use these tools from different classes to assess the overall department objectives.

The data collecting worksheet template is presented below:

Department of Engineering Technology										
Direct Course Objectives Assessment Template										
Course name and Number:							Semester and Year:			
Course learning objectives ( please write your objectives below)	Outcomes	Target	Assessment tools					Final	Mean	Deviation from Target
	A-K	score	T1	A1	T2	T3	A3			
1	ABF	80%								80%
2	ECD	75%								75%
3	ABF	75%								75%
4	GHE	70%								70%
5	AFE	80%								80%
6	ACD	80%								80%
Mean										
Standard deviation										
Action to be taken:										
1										
2										
3										
Note: As we all know the different objectives are assessed in different tests. So you do not have all the boxes filled in in one test. What you have to fill are the columns D through H if you need more than these columns please insert as needed. The lines to be fills are those corresponding to objectives only. The last to lines are formulas and will appear automatically.										

### 3.2 Indirect assessment tools:

Students in all courses are asked to complete a questionnaire about the course that they are about to finish. The questionnaire includes direct questions about the objectives and how do they evaluate the achieving of those objectives at the end of the semester. The students will be asked to rank the achievement of all course learning objectives. The department will summarize and analyze the results of these questionnaires and discuss them on two levels: Level one is with the instructor to test the conformance of these results with the direct assessment method. Level two is to compare these findings with the statistical indicators generated from direct assessment. The questionnaire produces the following summary statistical table for each course in the program:

Course:	Semester:		Instructor:				
	Rating of the objectives summary						
Course Learning Objectives	5 (achieved)	4	3	2	1 (Poorly achieved)	Total	Weighted average
1							
2							
3							
4							
Total							
% of the class							

The direct and indirect indicators will be used to finalize the action plan of closing the loop proposed by the instructor.

#### 4. Assessment statistics

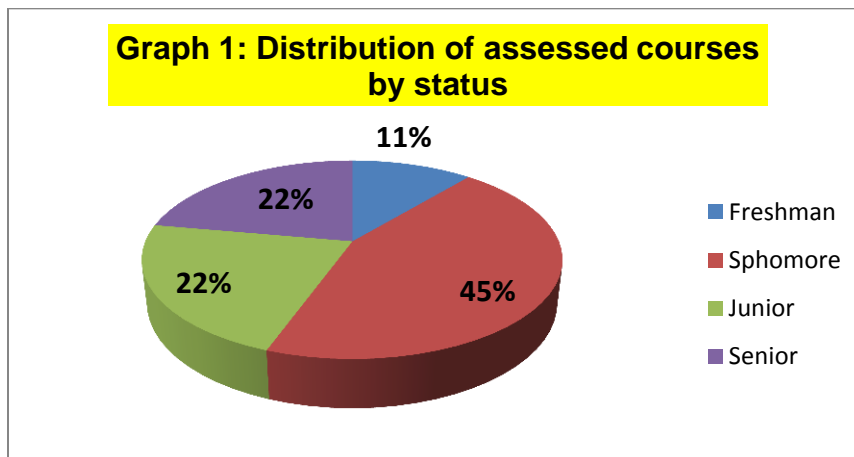
##### 4.1: Coverage of data

We are going to introduce and analyze data collected from one semester that involves a total of nine direct course assessment results and nine indirect course assessments results.

The selected courses are from all levels, freshman, sophomore, junior and senior as distributed in the following table.

**Table1: Course chosen for the study distributed by course level.**

Semester	Direct				Indirect				Total
	Freshman	Sophomore	Junior	Senior	Freshman	Sophomore	Junior	Senior	
Spring 2011	1	4	2	2	1	4	2	2	18
Spring 2012	1	4	6	2	1	4	6	2	26



##### 4.2 : Direct assessment data

The data used in direct assessment were collected over two semesters; spring 2011 and spring 2012. The data do not reflect the exact same courses, but there is some repetition that allows us to perform some comparative analysis.

### 4.2.1 Spring 2011 data

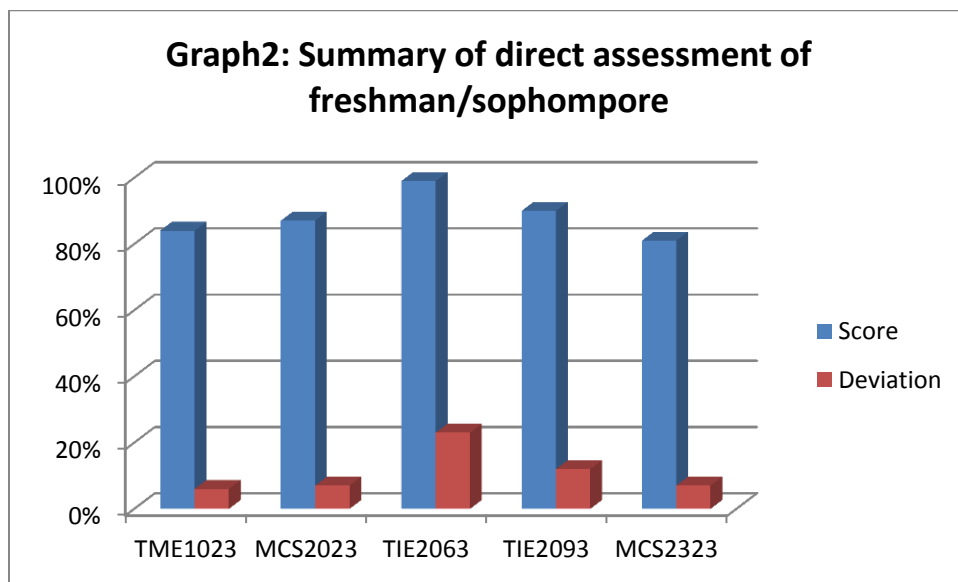
The data from nine courses were summarized and grouped in the following two tables; the first one represents the conclusions from the freshman sophomore courses as far as the final score and the deviation from target are concerned, while the second contains the same data for the junior senior level of the courses.

**Table 2: Outcome summary of the direct assessment for freshman/sophomore courses**

Objective	TME1023		MCS2023		TIE2063		TIE2093		MCS2323	
	score	deviation	score	deviation	score	deviation	score	deviation	score	deviation
1	82%	2%	88%	8%	98%	18%	96%	21%	78%	3%
2	83%	3%	85%	5%	97%	22%	87%	12%	85%	10%
3	82%	7%	87%	7%	100%	25%	88%	8%	82%	7%
4	81%	1%	90%	10%	100%	25%	88%	8%	78%	8%
5	91%	16%	84%	4%					82%	7%
6			88%	8%					83%	8%
7			85%	5%					78%	3%
8			87%	7%					81%	7%
Average	84%	6%	87%	7%	99%	23%	90%	12%	81%	7%

Since the number of course learning objectives is different from course to course, we had to mark them with numbers instead of the actual words of the objective. This will not affect our general analysis attempt, since the goal of the analysis is not the course content but the assessment results and the overall lesson learned from this exercise.

The above data are represented in the following chart.



The general conclusion from the table and the data is that the target score for the objectives were generally met and exceeded in all the courses. A question could be raised when the actual score exceed the target score significantly, Such as in TIE2063 where the actual achievement exceeded the target by 22.5%. The argument could be that either the target score does not reflect the level of mastery required or the test tools do not explore the missing skills of the students. It is recommended that when there is this kind of significant deviation from the target, whether the deviations is positive or negative, that the instructor should revisit the set of objectives, the delivery method, and the student course work evaluation.

If after a series of thorough analysis, there was no deficiency discovered, the target score for the objectives should be moved up.

The other course that showed positive deviation of more than 10% was TIE2093 where it indicated 12.3% above target achievement. This does not require, from our point of view, immediate attention and thorough investigation by the instructor as in the case of TIE2063, but it should raise a flag for monitoring the next assessment of the course. If the results are consistent, then moderate modifications of the objective and marginal adjustments to the target scores might be needed.

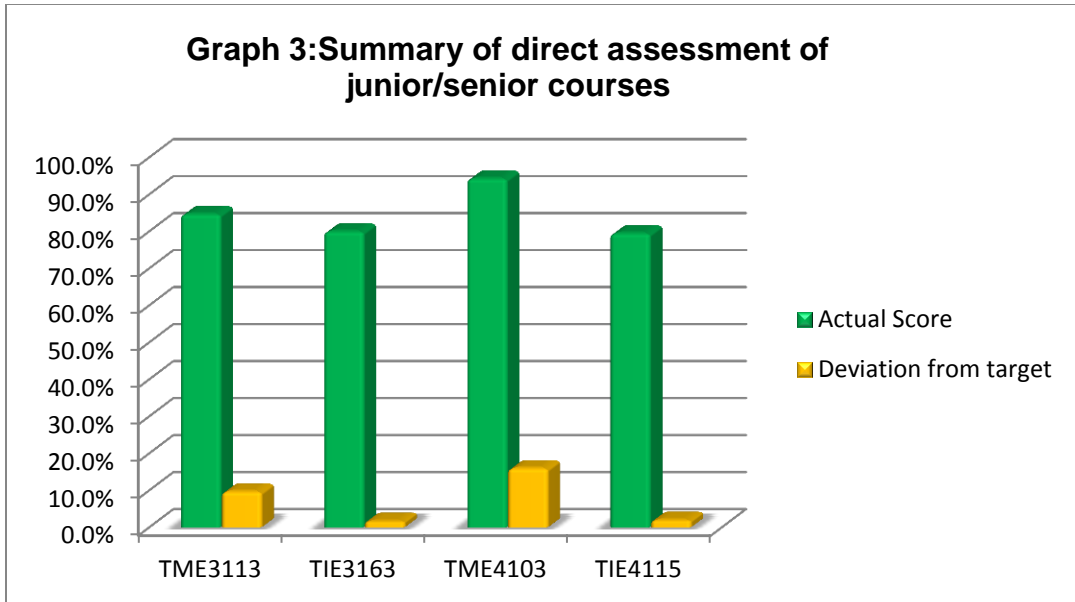
The other courses have exceeded the targets by 6-7%, which in our point of view is good and reasonable. The communication with students about the course learning objective and the target score that should be met will help the students understand, appreciate, and work to achieve the goals.

**Table 3: Outcome summary of the direct assessment for junior/senior courses**

Objective	TME3113		TIE3163		TME4103		TIE4115	
	score	deviation	score	deviation	score	deviation	score	deviation
1	85%	10%	81%	1%	92%	12%	80%	0%
2	85%	10%	77%	2%	91%	16%	77%	2%
3	84%	9%	82%	2%	100%	20%	83%	3%
4							78%	3%
5							80%	2%
Average	85%	10%	80%	2%	94%	16%	80%	2%

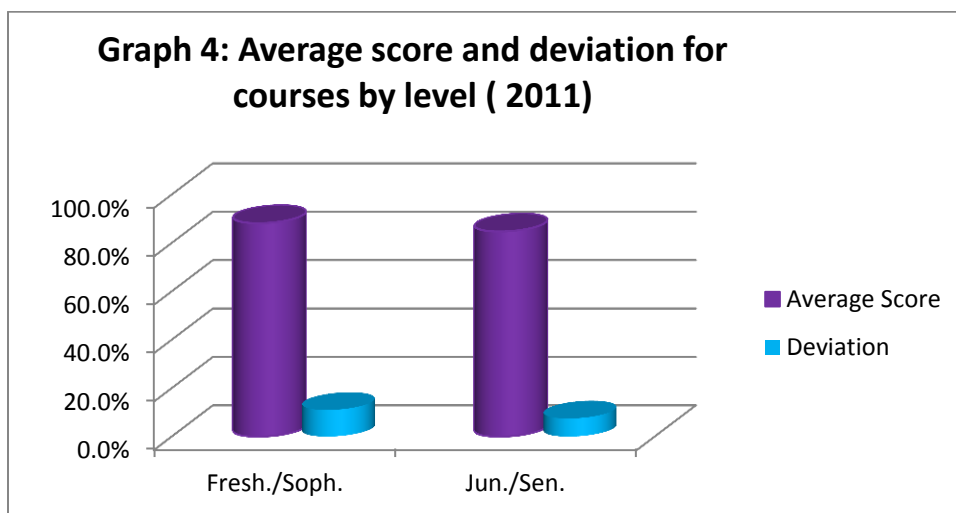
The first general note that could be noticed is that the number of course learning objectives is less in junior/senior than those of freshman/sophomore courses. This could be due to the fact that the earlier courses in the curriculum are designed to build foundations in different knowledge areas.





The junior /senior group of courses shows same pattern, one of junior and one of senior courses were 9.7% and 16% above target while the other were quite moderate in exceeding the target. The argument about TIE 2063 in the freshman/ sophomore group could be valid. We would even say that as a senior class, if the objectives, the coverage, and the evaluation set of tools are equal for senior level, then the target score should be moved up.

To have a general comparison between the two course levels, we have calculated the averages of each group and present them in the following chart.



It is clear that the general picture shows that both the average actual scores and the average deviation were both higher for the freshman/ sophomore courses.

The overall actual average score by objective for the freshman/sophomore level was 88.0%, while it was 84.6% for the junior/senior courses. The deviation from the target score averaged 10.8 above the target for the freshman/sophomore course, while it averaged only 7.4% above target score for junior/senior courses.

#### 4.2.2 Spring 2012 Data

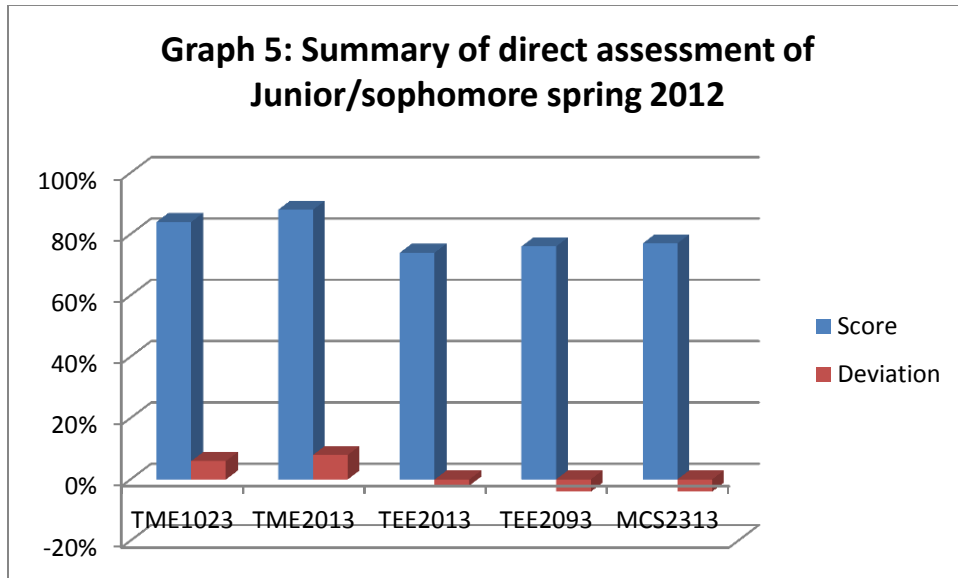
In spring 2012 a total of thirteen courses were assessed; five of them were freshman/sophomore and eight were junior/senior level. We summarized the data using the same model that we have used for spring 2011 data.

Table 4: Outcome summary of the direct assessment for freshman/sophomore courses

Objective	TME1023		TME2013		TEE2013		TEE2093		MCS2313	
	Score	Deviation	Score	Deviation	Score	Deviation	Score	Deviation	Score	Deviation
1	84%	4%	80%	0%	71%	-4%	70%	-10%	87%	2%
2	85%	5%	89%	9%	79%	4%	75%	-5%	76%	-4%
3	80%	5%	89%	9%	79%	4%	76%	-4%	75%	-5%
4	82%	2%	94%	14%	64%	-11%	80%	0%	78%	-2%
5	90%	15%			79%	-1%	80%	0%	74%	-6%
6							73%	-7%	70%	-10%
7										
Average	84%	6%	88%	8%	74%	-2%	76%	-4%	77%	-4%

Of the above five courses, there was only one course that was re-evaluated in spring 2011. We have to mention here that normally; the assessment cycle could be once a year.

The chart below shows the above statistics.



Unlike the result of 2011 direct assessment results, the spring 2012 highlight three courses of the freshman/sophomore family that did not meet the instructors assigned target of mastery. These courses were TEE 2013, TEE2093 and MCS2313. The discussion that we had with course’s instructors revealed a strong correlation between the causes of this deficiency in reaching the target. The cause of the effect was lack of Algebraic skills.

This issue would not surface if the assessment was not performed, which provide an argument about the importance of the assessment process to programs and departments and Instructors of these courses.

Results of the assessed eight junior/senior courses are presented in the following table:

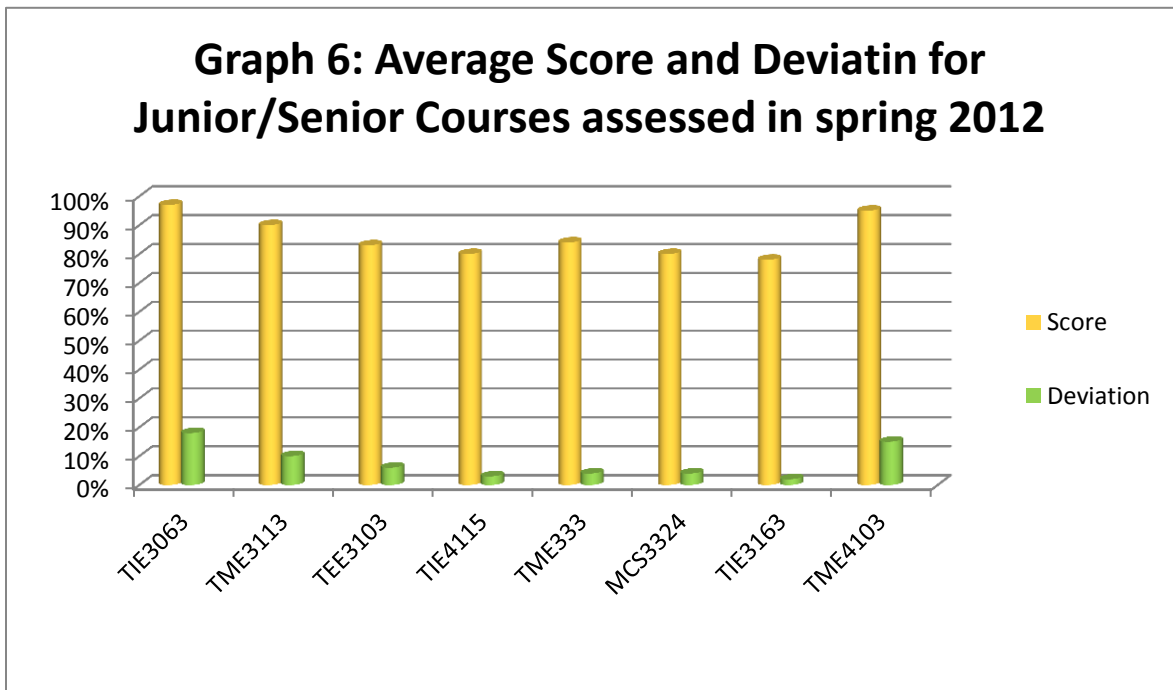
**Table 5: Outcome summary of direct assessment for junior/senior courses spring 2012**

Objective	TIE3063		TME3113		TEE3103		TIE4115		TME333		MCS3324		TIE3163		TME4103	
	Score	Deviation	Score	Deviation	Score	Deviation	Score	Deviation	Score	Deviation	Score	Deviation	Score	Deviation	Score	Deviation
1	95%	15%	88%	8%	81%	1%	81%	1%	88%	8%	75%	-5%	76%	4%	92%	12%
2	95%	15%	87%	7%	81%	6%	79%	4%	85%	5%	85%	5%	75%	0%	93%	13%
3	100%	20%	96%	16%	81%	1%	82%	2%	85%	5%	80%	5%	72%	-2%	100%	20%
4	100%	20%			81%	11%	78%	3%	85%	5%	75%	0%	74%	1%		
5					84%	4%			80%	0%	80%	5%	91%	9%		
6					84%	9%			85%	5%	85%	10%	78%	2%		
7					92%	12%			80%	0%	80%	5%				
Total	97%	18%	90%	10%	83%	6%	80%	3%	84%	4%	80%	4%	78%	2%	95%	15%

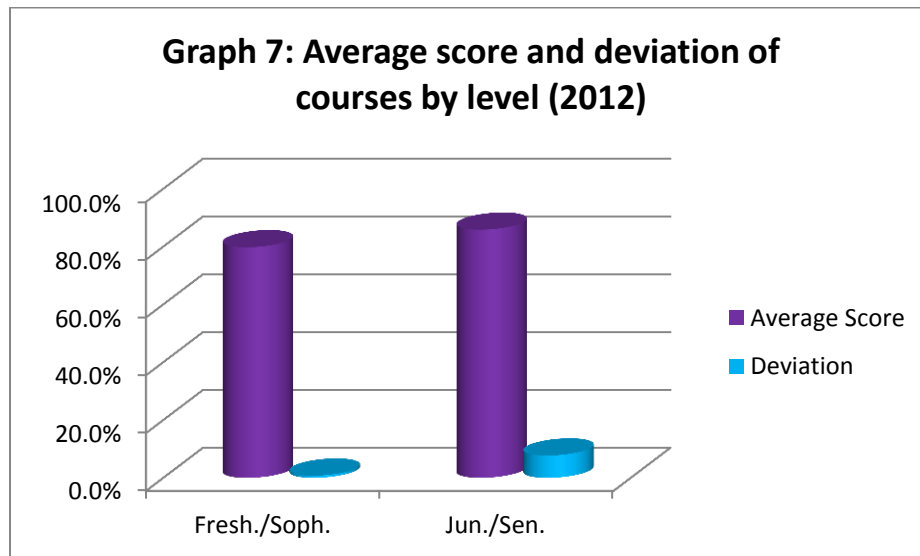
All four junior/senior courses that were assessed in spring 2011 were assessed again in spring 2012, with addition of four newly assessed courses. It is noticed from spring 2012 results that some instructors have made adjustments on their target score plans based on the findings from spring 2012 data. Unlike the case of the freshman/sophomore data, the junior/senior data provide indications that all these courses met and exceeded the target score set by the instructor.

Conclusions from the above table are highlighted in the following graph.

**Graph 6: Average Score and Deviatin for Junior/Senior Courses assessed in spring 2012**



The following chart provides a comparison between the two sets of courses evaluated.

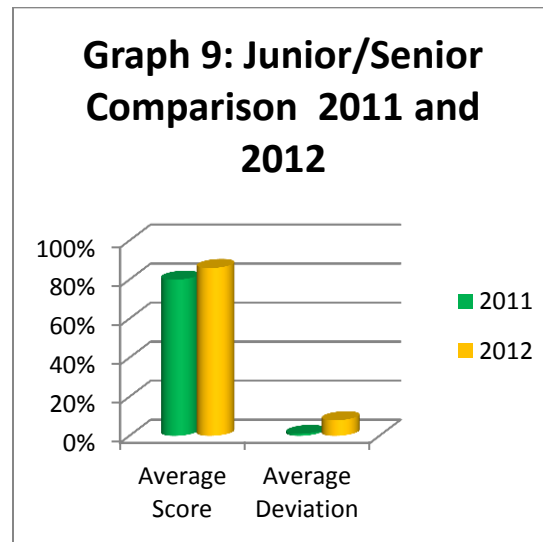
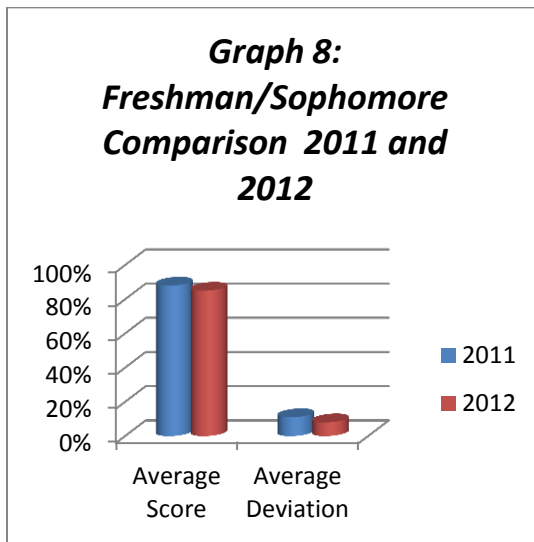


It is clear that achieving educational objectives of courses offered is better for junior/senior level courses than those for freshmen/sophomore level.

This fact provides an agenda item for discussion in the department meetings.

### 4.2.3 Comparing spring 2011 and spring 2012 data

Since the data coverage of spring 2011 and spring 2012 are not identical, we cannot perform a course to course comparison, yet we can still have a general review of the two semester's average scores and deviations to have an overall review at the educational performance in the two semesters. These data are explored in the graphs below:



It could be noted that junior/senior assessed courses shows improvement in reaching the target scores in 2012 from 2011 unlike the freshman/sophomore courses, which indicates slight decline in achieving the goals.

### 4.3 : Indirect assessment data

#### 4.3.1 Spring 2011

Since we are trying to analyze direct and indirect assessment results for consistency, we have collected data for the same nine courses that we have presented in 4.2.1

The data in tables five and six below represent the percentages of students ranking for each objective of all assessed courses. As we may note from the tables there are no ranking for any objective in all the assessed courses that is less than three, which indicates that the objectives were reasonably met for all the curriculum from the point of view of students.

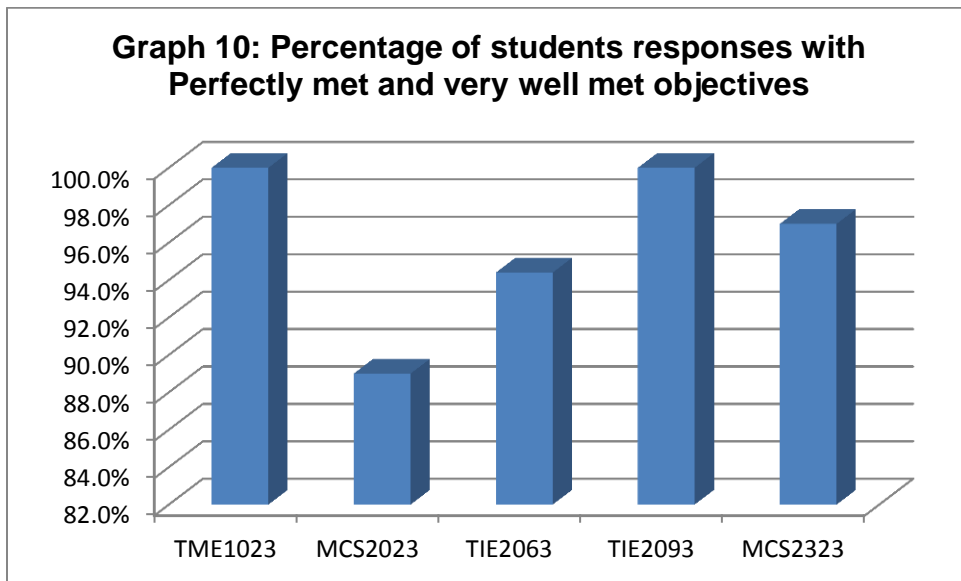
Table 6: Outcome summary of the indirect assessment for freshman/sophomore courses

Objective	TME1023			MCS2023			TIE2063			TIE2093			MCS2323		
	5	4	3	5	4	3	5	4	3	5	4	3	5	4	3
1	100%	0%		62%	33%	5%	66.7%	22.2%	1.1%	100%			54%	46%	
2	90%	10%		62%	33%	5%	55.6%	44.6%	0.0%	80%	20%		46%	54%	
3	90%	10%		67%	28%	5%	66.7%	33.3%	0.0%	80%	20%		54%	46%	
4	90%	10%		56%	28%	16%	66.7%	22.2%	1.1%	40%	60%		69%	31%	
5	80%	20%		56%	28%	16%							62%	31%	7%
6				62%	22%	17%							46%	46%	8%
7				62%	33%	5%							54%	39%	7%
8				67%	28%	5%							69%	31%	

5: Perfectly Met 4: Very well met 3: Reasonably met

The data show that the majority of the students do believe that the course learning objectives have been either perfectly met or very well met (rank 5 and 4).

The chart below represents the percentages of the students who ranked meeting the objectives with four or five.



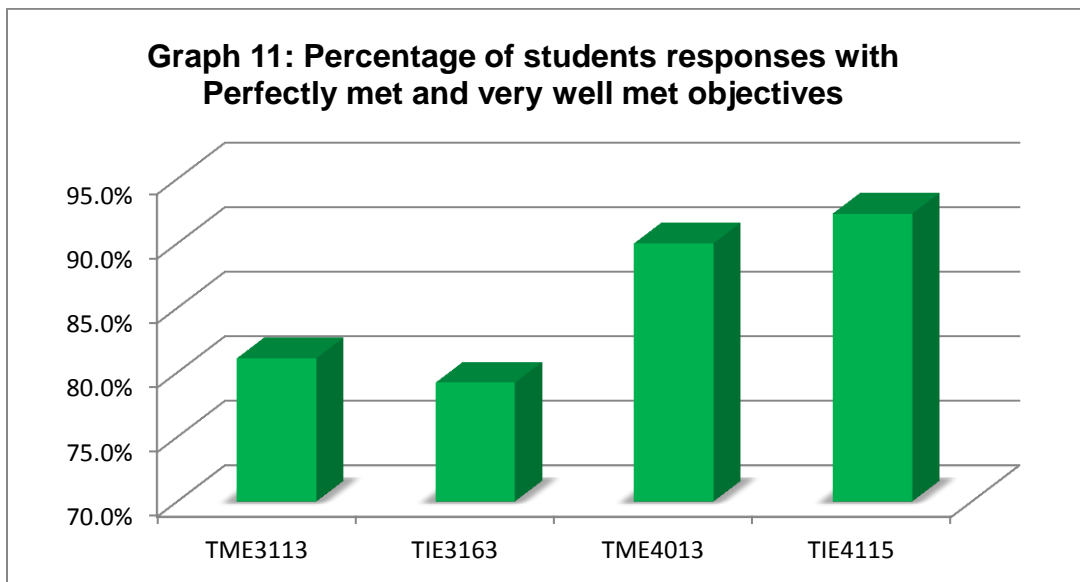
Although the percentages were 90% or more, it looks like MCS 2023 was the lowest of the freshman/sophomore group. Knowing this is a statistics course might explain that partially, since the students normally do have some kind of discomfort when it comes to math courses.

The only course that has all objectives ranked either perfectly met or very well met was TIE3163 in the junior/senior group of courses. Students have ranked some of the objectives as reasonably met in the rest of courses.

Objective	TME3113			TIE3163			TME4013			TIE4115		
	5	4	3	5	4	3	5	4	3	5	4	3
1	57.1%	14.3%	28.6%	50.0%	50.0%		80.0%	10.0%	10.0%	78.1%	18.8%	3.1%
2	42.9%	42.9%	14.2%	60.0%	40.0%		70.0%	20.0%	10.0%	78.1%	21.9%	0.0%
3	57.1%	28.6%	14.3%	60.0%	40.0%		90.0%	10.0%	0.0%	56.3%	40.6%	3.1%
4										75.0%	21.8%	3.2%
5												
6												
7												
8												

5: Perfectly Met    4: Very well met    3: Reasonably met

The percentages of ranks four and five varied between the four junior/senior courses. Data indicate that students in senior courses believe that the objectives of their courses were almost perfectly met



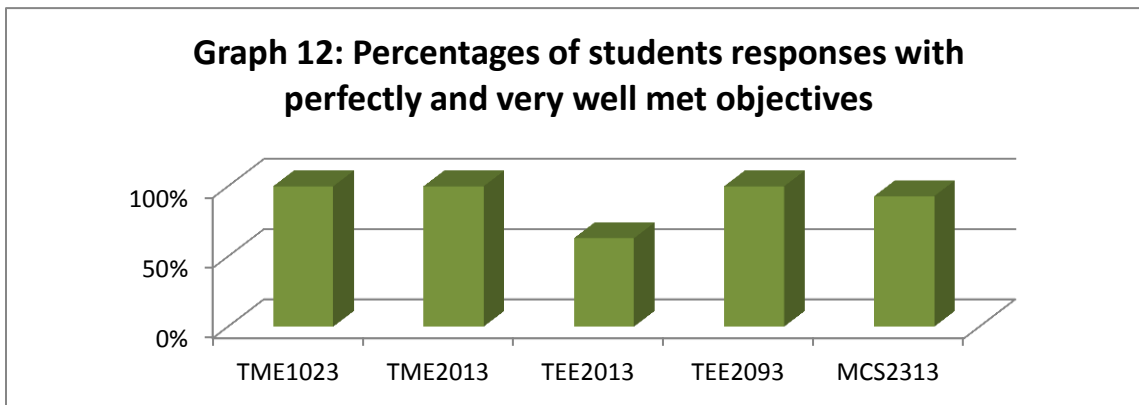
#### 4.3.2 Spring 2012 data

Using the same pattern of data presentation used for 2011 data, table eight below presents the summary of the freshman/sophomore courses.

Table 8: Outcome summary for indirect assessment of freshman/sophomore courses: spring 2012

	TME1023			TME2013			TEE2013			TEE2093			MCS2313		
Objective	5	4	3	5	4	3	5	4	3	5	4	3	5	4	3
1	93%	7%		75%	25%		17%	33%	50%	67%	33%		82%	18%	0%
2	93%	7%		50%	50%		17%	50%	33%	100%	0%		82%	18%	0%
3	100%	0%		50%	50%		50%	33%	17%	67%	33%		55%	36%	9%
4	67%	33%		50%	50%		17%	17%	67%	67%	33%		64%	36%	0%
5	87%	13%					67%	17%	17%	100%	0%		36%	55%	9%
6										67%	33%		28%	45%	27%
Average	88%	12%		56%	44%		33%	30%	37%	78%	22%		58%	35%	7%

As was the case in 2011, there was no rank given to any objective in any course below rank 3. This time, three out of five courses did not have any rank below four for any objective, versus two in 2011. It is obvious though that fluctuation exists between this level of courses. We can note that the following chart does show that percentage of students high ranking the last three courses of the series is lower than the first two courses. The results here provide a solid indication of consistency with the results obtained from the direct assessment.



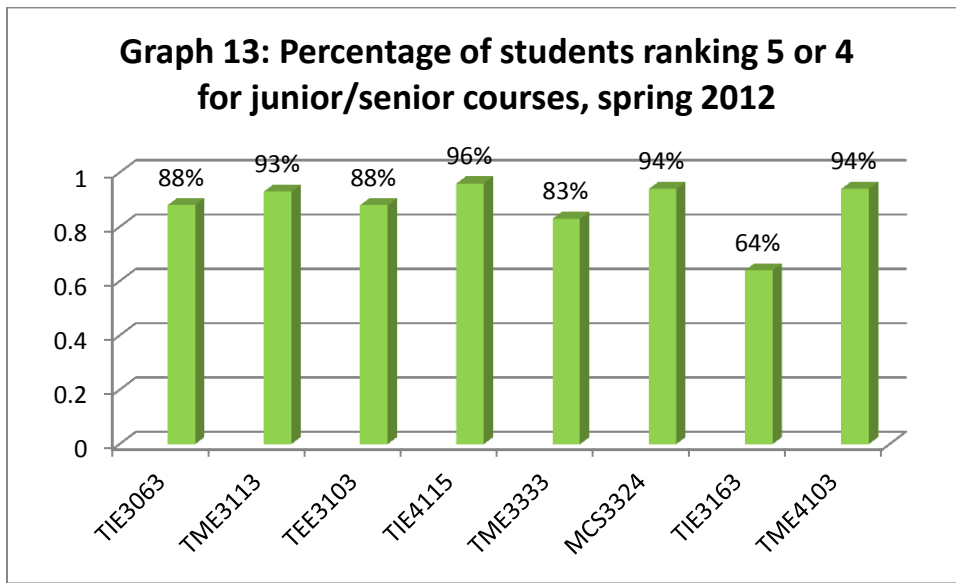
As in the case of direct assessment, results from the indirect assessment of the eight junior/senior levels are summarized in table nine below.



Table 9: Summary of indirect assessment of junior/senior courses, spring 2012

Objective	TIE3063			TME3113			TEE3103			TIE4115			TME3333			MCS3324			TIE3163			TME4103		
	5	4	3	5	4	3	5	4	3	5	4	3	5	4	3	5	4	3	5	4	3	5	4	3
1	50%	50%	0%	33%	44%	23%	88%	12%		75%	20%	5%	60%	40%	0%	60%	40%	0%	27%	27%	47%	82%	9%	9%
2	100%	0%	0%	78%	22%		75%	25%		80%	20%	0%	40%	40%	20%	70%	30%	0%	40%	20%	40%	82%	9%	9%
3	50%	50%	0%	89%	11%		63%	37%		60%	35%	5%	40%	60%	0%	60%	40%	0%	27%	33%	40%	82%	18%	
4	50%	0%	50%				63%	25%	12%	75%	20%	5%	60%	40%	0%	40%	50%	10%	27%	33%	40%			
5							13%	63%	24%				20%	40%	40%	60%	40%	0%	47%	40%	13%			
6							13%	63%	24%				40%	20%	40%	40%	50%	10%						
7							63%	12%	25%				40%	40%	20%	60%	20%	20%						
Average	63%	25%	12%	67%	26%	23%	54%	34%	21%	72%	24%	4%	43%	40%	17%	55%	39%	6%	33%	31%	36%	82%	12%	9%

The general level of student’s satisfaction looks acceptable and consistent with the direct assessment result. The highest average percentage of ranks was rank 5 in all the courses but TIE3163, which is consistent with the direct assessment of this course. Also, the percentage of rank 3 is the highest in all courses on both semesters. As a matter of fact, the department did follow up on the performance of this course through the semester since some problems were noticed.



We may conclude that the fluctuation between courses exists in the indirect assessment just like in direct assessment; the pattern is the same to support the consistency of the model.

#### 4.4 : Comparison between Direct and indirect data

The assumptions of the model are that the delivery method, course learning objectives, student’s performance and the overall practice during the semester serve the educational goal of the course. If these assumptions are met, then both assessment methods, the direct and the indirect, should be consistent.

From the above data presentation and analysis, we can tell that in general there is harmony between results from both methods of assessing.

As indicated earlier, each set of data were collected differently. The direct assessment data reflect the average performance of students in their homework, assignments, quizzes and tests. The indirect assessment data represent ranking of the meeting of the learning objectives from the student’s point of view. To come up with some statistical indicator that allows us to acquire some measurement that could be statistically comparable to the average performance in the direct assessment, we have calculated the weighted average of ranks by assuming that each rank represents a percentage of achievement. This means that rank five was treated as 100%, rank 4 as 80% and rank 3 as 60%. The weight for each rank was the number of students voting for this rank.

Table 10 contains the percentages from the direct assessment for all the objectives and the weighted average percentage of the student ranks for all the assessed nine courses.

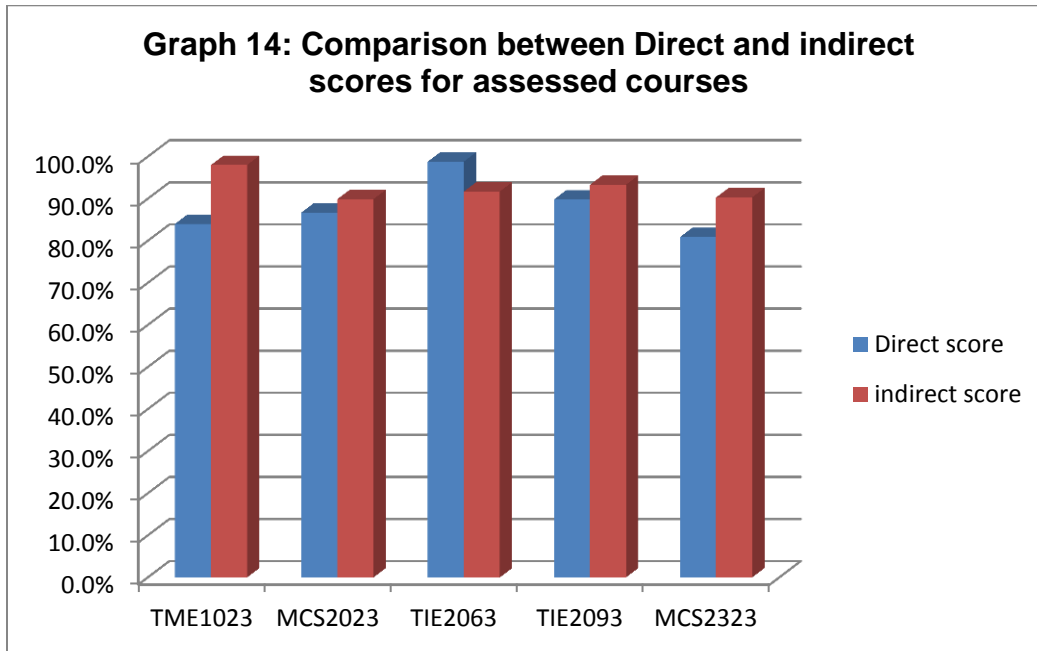
**Table 10: Scores from students work and students ranking for learning objectives by course Spring 20122**

Course	Direct score	indirect score
TME1023	84.0%	98.0%
MCS2023	86.7%	89.9%
TIE2063	98.8%	91.7%
TIE2093	89.8%	93.3%
MCS2323	80.9%	90.3%
TME3113	84.7%	86.7%
TIE3163	80.0%	91.3%
TME4013	94.3%	94.7%
TIE4115	79.5%	93.9%

It should be noted from the table that the scores of the students reflects a higher level of achievement of the objectives from what their actual scores show. In some of the courses the difference are significantly higher from the direct data. The only departure from that fact is

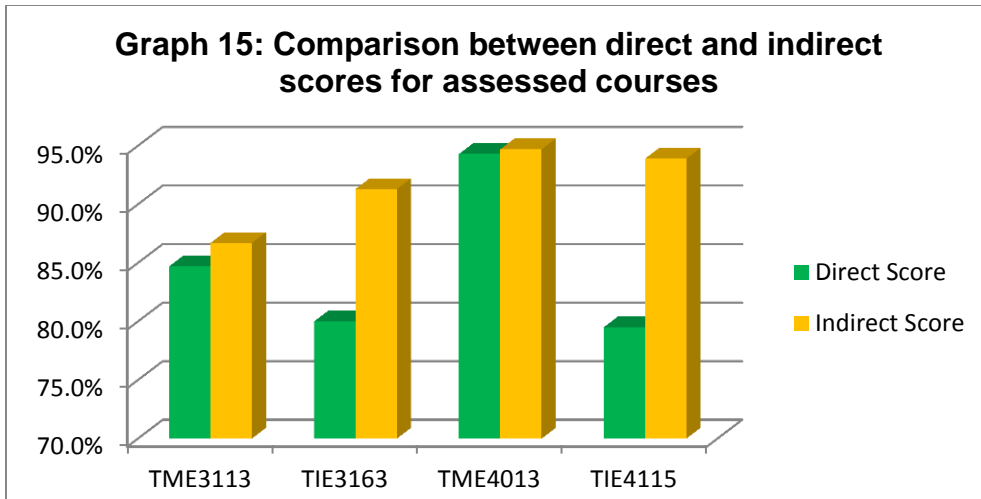
TIE2063, which happened to have very high scores from the direct method. This fact aligns with our statement earlier about exceeding the target by 22.5%.

The freshman/sophomore courses comparison are better explored in the chart below.



As for the junior/ senior level courses, the students scored the achievement of objectives significantly higher than what the direct assessment scores provided.

The most significant difference comes from TIE4115, the senior project five-credit course. The students in this course do learn and practice how to solve real-world industrial problems. The course represents the highlight of the BSET program, which might be the reason for the students to rank it highly.



The picture in spring 2012 was as presented in table 11 below.

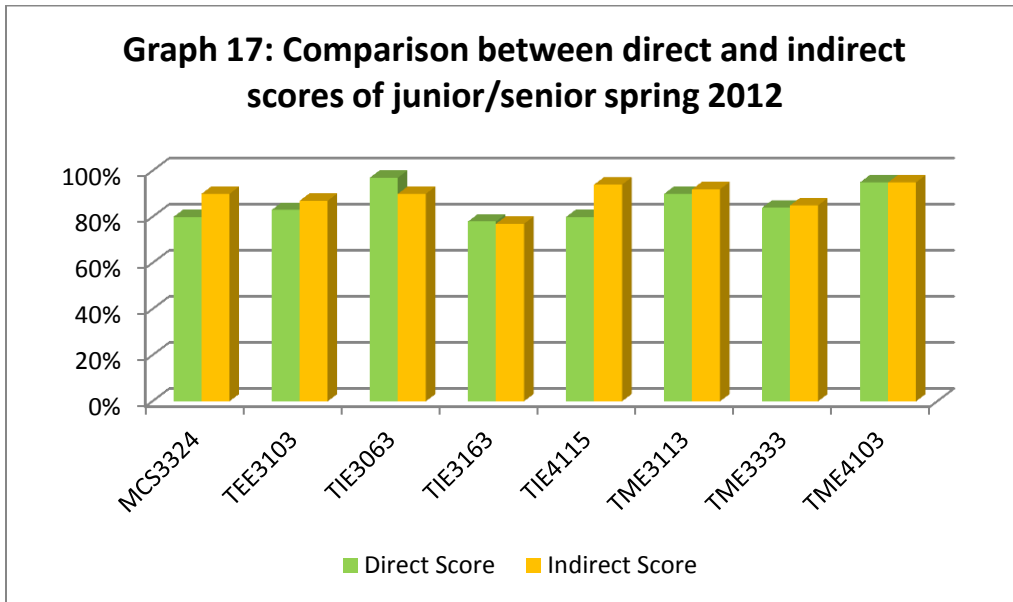
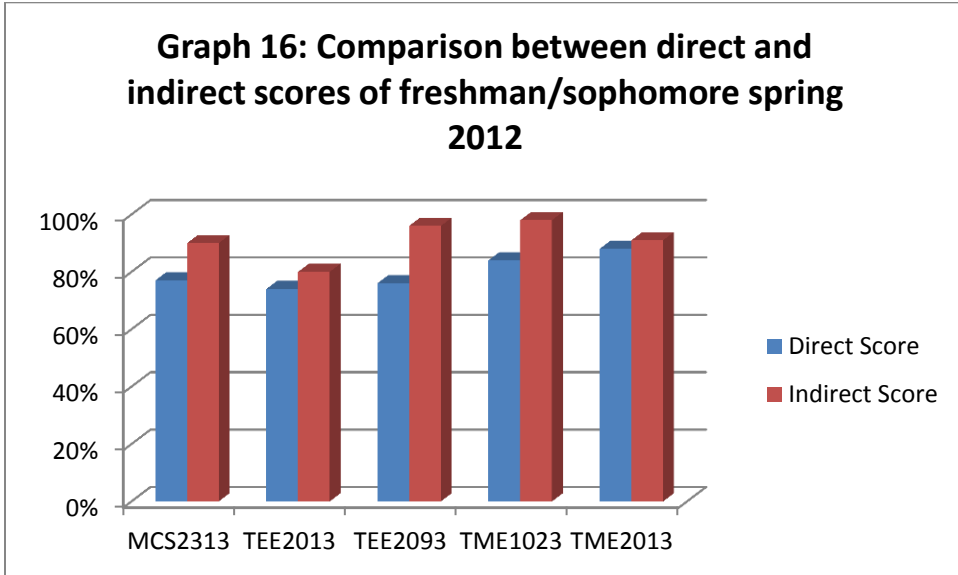
**Table 11: Comparison between direct and indirect scores for spring 2012**

Course	Direct Score	Indirect Score
MCS2313	77%	90%
MCS3324	80%	90%
TEE2013	74%	80%
TEE2093	76%	96%
TEE3103	83%	87%
TIE3063	97%	90%
TIE3163	78%	77%
TIE4115	80%	94%
TME1023	84%	98%
TME2013	88%	91%
TME3113	90%	92%
TME3333	84%	85%
TME4103	95%	95%

Data of all courses in spring 2012 indicated a better indirect score than the direct score with the exception of TIE3163, which had slightly, lower indirect score.

The general conclusion supports the consistency of the model since there is agreement between results of both assessment methods.

The following two charts show the results presents in the previous table for both freshman/sophomore and junior/senior levels.



## **5. : Conclusions and recommendations**

Our conclusions from the analysis of this model and related statistics are:

- i. The model is a powerful tool that could help the instructor, program, and department to capture major successes and failure in the delivery of a course.
- ii. Based on the above conclusion, the model can be used to adjust the course learning objective target, hence it helps improving the learning process.
- iii. A repeated use of the model for the same courses could be a valuable tool in analysis of different instructors and different student group's performance.

We recommend a continuation of the study of the same courses assessment from different semester in the future. We believe that this comparative study will provide valuable data and could reveal some lessons that could be learned.

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