

## Open Learning Electronic Teaching and Learning Resources to Enhance Performance in Statistics of AP Students

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### Abstract

Enhancing current teaching practice may help to change the perception that statistics is difficult to learn and instill confidence in both instructors and learners. Findings from comparing achievements of students in Statistics for Science and Engineering (STA408) paper in the final semester examination found that Applied Science (AS) students performed better on the overall as well as at four specific items than the Architecture, Planning and Surveying (AP) students. This article highlights the proposed use of technology at improving students' performance in two topics with lowest achievement by AP students, namely Estimation & Hypothesis Testing and Regression & Correlation. User friendly software such as Prezi, Powtoon and Screencast-O-Matic are used to implement e-learning approaches through Massive Open Online Courses (MOOC).

Keywords: Estimation, Hypothesis Testing, MOOC, Open Learning, Technology.

### Introduction

A positive attitude to learning statistics may have been the effect of secondary school teaching but statistics is a subject found by many students to be difficult and requires a great deal of discipline and time to learn [1]. Enhancing current teaching practice may help to change this perception and instill confidence in both instructors and learners. In particular, seven ways technology may enhance learning fundamental ideas in statistics include i) use of real data may contribute to understanding what is represented by statistic, ii) help students to build intuition about variability through graphical representations, iii) allow students to engage in statistical reasoning, iv) make iterative processes easier for students to carry out, v) enable students to associate real phenomena through the use of a mathematical model, vi) enhance students' understanding of probability by allowing them to explore and represent statistical models and vii) simplify the concepts involved in sampling and inference [2].

Technology use and real data sets may not automatically increase motivation and enhance learning basic courses in probability and statistics. Integrating and aligning learning activities which include the use of digital resources to assessment have helped at

improving the performance of Engineering students in the final exam for this course at Lund Institute of Technology [3]. In another learning environment, use of Minitab has helped to ease the difficulties experienced by students at learning statistical terms, graphical representations as well as calculations involving measures of central tendency and variations [4]. Teaching statistics with examples may also show students the relevance of statistics in everyday life, thus a multimedia clip of the National Basketball Association athletes Michael Jordan and LeBron James has been used in a learning activity in order to engage students in understanding summary statistics and graphical techniques [5].

Students' achievements at certain items in the curriculum can be used as an indicator of the strength and weakness of a teaching approach used for a particular topic. This article presents the comparative analysis of results obtained in the Statistics for Science and Engineering (STA408) paper in the final semester examination by students from two different faculties at Universiti Teknologi MARA (UiTM) Cawangan Perlis. The analysis aimed to determine specific possible areas or topics in the curriculum that were difficult for students to comprehend. This analysis is presented here in the light of proposing the use of *Open Learning Electronic Teaching and Learning Resources* at

improving teaching for understanding specific items of Statistics.

## Method

Participants in the study were 213 UiTM Cawangan Perlis students from two consecutive semesters who took the STA408 course. The students were enrolled in Bachelor of Surveying Science and Geomatics (Honours) from the Faculty of Architecture, Planning and Surveying (AP) and Bachelor of Science (Hons) Polymer Technology and Bachelor of Science (Hons) Applied Chemistry from the Faculty of Applied Sciences (AS). Their performance was measured according to their final overall score consisting of a 40% continuous assessment score of work done throughout the semester and 60% of the final examination score.

There are four topics covered in STA408; Probability Distribution, Estimation and Hypothesis Testing, Analysis of Variance, Regression and Correlation. In the final examination, each topic has one question with a total score of 20 points each, except for Estimation and Hypothesis Testing. This topic has two questions with a total score of 40 points. This score is averaged so that the total score is also 20 points.

An independent-samples t-test was conducted to compare students' performance in STA408 from two different faculties, AP and AS. Further comparison is made on 4 different topics in STA408: Probability Distribution, Estimation & Hypothesis Testing, Analysis of Variance, Regression & Correlation. The mean score for each topic was calculated and an independent sample t-test was conducted to compare the students' performance in each of the topics. Based on these findings, this article highlights the importance of building *Open Learning Electronic Teaching and Learning Resources* which are designed to improve teaching of these items.

## Results and discussion

Table 1 and Table 2 displays the descriptive statistics for AP and AS students, and results from T-test comparing means of AP and AS in STA408 respectively. There was a significant difference in the performance for AP ( $M=60.7$ ,  $SD=15.9$ ,  $N = 70$ ) and AS ( $M=77.8$ ,  $SD=12.3$ ,  $N = 143$ ) with  $t(111)=-7.924$  and  $p = 0.000$ . These results suggest that students' attachment to a particular faculty does have an effect on their performance in STA408. Specifically, AS

students taking STA408 displayed better performance than AP students.

Table 1: Descriptive Statistics for AP and AS Students

	N	Mean	Standard deviation
AP	70	60.69	15.88
AS	143	77.81	12.34

Table 2: T-Test comparing Means of AP and AS Students' Performance in STA408

	T	Df	P value
Score	-7.924	111	0.000

Further comparison was made to compare the performance of these students at 4 different topics in STA408 (Probability Distribution, Estimation and Hypothesis Testing, Analysis of Variance, Regression and Correlation). In addition, an independent sample t-test was conducted to compare the students' performance in each of the topics. Results are displayed in Table 3 and Table 4.

Table 3: T-Test comparing Means of AP and AS Students' Performance according to Four Topics in STA408

	T	Df	P value
Probability Distribution	-4.350	106	0.000
Estimation & Hypothesis Testing	-9.106	102	0.000
Analysis of Variance	-3.674	102	0.000
Regression & Correlation	-5.219	98	0.000

Table 4: Descriptive Statistics for AP and AS Students at Four Topics in STA408

Topics	AP			AS		
	N	Mean	Standard deviation	N	Mean	Standard deviation
Probability Distribution	70	14.06	4.53	143	16.7	3.31
Estimation & Hypothesis Testing	70	10.03	4.20	143	15.12	2.92
Analysis of Variance	70	16.13	4.08	143	18.12	2.83
Regression & Correlation	70	12.88	4.97	143	16.29	3.24

From Table 3, there are significant differences in performance between both groups on these four topics. The mean scores obtained for each topic show that AS students performed better than AP students in all topics. Further observation of these scores indicates that AP students had difficulty understanding two topics: (1) Estimation & Hypothesis Testing and (2) Regression & Correlation. This is evidenced by the respective descriptive statistics in Estimation & Hypothesis Testing for AP students ( $M=10.03$ ,  $SD=4.2$ ,  $N = 70$ ) and AS students ( $M=15.2$ ,  $SD=2.92$ ,  $N = 143$ ) as well as in Regression & Correlation for AP students ( $M=12.88$ ,  $SD=4.97$ ,  $N = 70$ ) and AS students ( $M=16.29$ ,  $SD=3.24$ ,  $N = 143$ ).

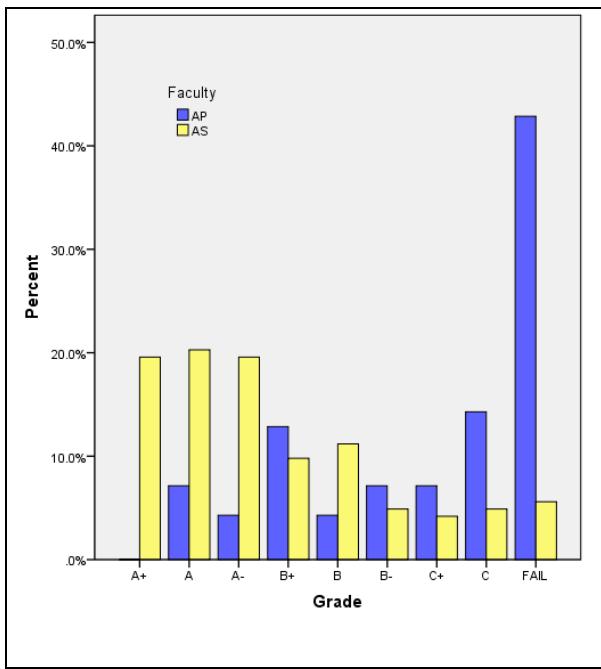


Figure 1: Students Performance in Estimation & Hypothesis Testing

Results from this study, as shown in Figure 1 also indicated that the performance scores in Estimation & Hypothesis Testing topic during the final examination of AS students surpassed those of AP students. They achieved higher percentages of grades A+, A, A- and B in that topic. It should also be highlighted that there were higher percentages of failure and grade C among AP students in this specific topic. Similar pattern is also true with respect to Regression & Correlation as shown in Figure 2. AS students outperformed AP students with higher percentages of grades A+, A and B-. Meanwhile, AP students displayed higher percentage of failure in this topic.

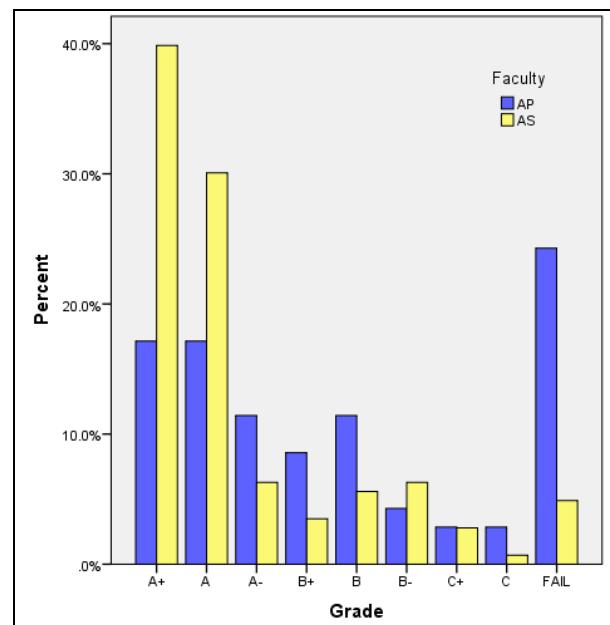


Figure 2: Students Performance in Regression & Correlation

Based on the above findings, this article wishes to highlight the proposed use of the Open Learning Electronic Teaching and Learning Resources at improving teaching for understanding Estimation & Hypothesis Testing and Regression & Correlation in STA408. To improve the learning and teaching processes, technology application is used by lecturers to deliver content to students. In Massive Open Online Courses (MOOC), materials are presented in a more interesting and attractive way and can be used to guide and help students in their learning process. This material includes notes, MINITAB hands on, online quizzes and test. The students can also answer and submit the quiz and/or test and an immediate feedback with scores can be obtained. Moreover, they can easily download all this material anywhere and anytime. By applying this method, students will better understand this subject and the gap between AS and AP students' performance in the final examination can be minimized.

While this study has proposed the use of technology via MOOC, it has not been proven that the developed materials have positive effects on their understanding and performance in the two topics. This unanswered question require further study and we proposed that a continual assessment on student's understanding while using MOOC be done. A pre-test and post-test can be given to the students while controlling other factors that might influence the outcome. Possible factors to consider could be gender, previous courses taken and program entry requirement.

## Conclusion

Analysis was done to compare performances by AP and AT students in STA408 found AS students to show better achievements than AP students. In addition, AS students have also outperformed AP at all four topics tested in the final exam. In particular, the analysis has found AP students unable to achieve success at items involving Estimation & Hypothesis Testing and Regression & Correlation. Therefore, this article highlights the use of technology in delivering instructional materials involving these items in MOOC.

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