

A New Teaching Approach for Improved Learning of Elementary Statistics

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Abstract: *Elementary Statistics is offered as a servicing course every semester, involving over a thousand students in classes of about fifty. The persistent issue of high failure rates among students continues to add burden to resources as the repeaters must retake the course until they pass in order to graduate. This study revisits the teaching and learning methods and proposes a new teaching approach by incorporating e-learning and student-centred learning to engage students effectively for better understanding and promote critical thinking. The new teaching approach was effective in improving overall affect: students' feelings about statistics. Students felt more comfortable in class, and the teaching and learning process became more fun. Their anxieties towards statistics were also reduced when they realized that the calculations were not that complex. To conclude, a student-centered learning approach with daily motivation and continuous quality improvement efforts is possible to change the attitudes of students towards statistics: from fear to fun effective learning.*

Keywords: *teaching statistics, learning empowerment, e-learning*

1. Introduction

The importance of Statistics in every field of knowledge and practice is undeniable; statistical skills are critical for university graduates to survive and excel in their chosen career. Accordingly, Statistics is a pre-requisite course for graduating especially for business and management fields. As an eminent management university, UUM under the School of Quantitative Sciences (SQS) offers servicing course of SQQS1013 Elementary Statistics every semester, involving over a thousand students in classes of about fifty. Several problems have been persistent for many years, primarily high failure rates for example, more than 20% in semester A121. Another is lack of motivation as evident by poor attendance. These problems require corrective actions in order to sustain our academic reputation as well as enhancing customer satisfaction. Thus, this research study is undertaken to resolve the main issue of high failure rates by improving the teaching and learning of the course.

Generally, the subject of statistics is sub-divided into main categories: collection of data, analysis of data, and inference from data (Moore, 2006). Among factors affecting student performance are English competency, attitude towards course, attendance and participation, as well as math anxiety (Zimmer & Fuller, 1996). The fear of mathematics interferes with learning mathematics which leads to more negative math experiences (Preis & Biggs, 2001) A study on workbook curriculum (Carlson & Winquist, 2011), required students to read content before and during class and then work in groups to complete problems and answer conceptual questions pertaining to the material they read. Researchers have presented evidence that students' exam scores are higher when taught with an active learning approach than when taught with more traditional approaches (Ryan, 2006; Christopher & Marek, 2009).

2. Teaching and Learning of Elementary Statistics

2.1. Current teaching scenario

The current method of teaching is teacher-centered learning, which is passive learning. Lecturers use visual aids in the form of presentation slides, whiteboard and visualizer. To encourage participation,

interactive class activities are sometimes initiated by individual lecturer, but the overall lessons remain teacher-centred. The final course marks are composed of 50% coursework and 50% final examination. The former consists of 5% Quiz, 20% Group Assignment and 25 % Test. Currently, the approach of group assignments is examination-oriented and does not encourage in-depth statistical thinking. To improve the teaching and learning of this course, we propose to enhance the overall teaching approach to better engage learners.

Based on feedback from the former students, the following issues have been regarded as causes of their difficulties in learning statistics. These are English proficiency, fear of numbers and symbols, and lack of practice or exercises especially on the last two chapters. The first two items are very much student-dependent as they concern self-competency as well as perception and attitude. It is mandatory that the course be taught in full English. A way to alleviate the problems is to consistently motivate them while delivering the lessons in ways that make learning easy (or seemingly). For example, the slides are provided upfront and students are reminded to look up the meaning of any unfamiliar words or symbols. Upon further probing, the lack of practice of the last two chapters stems from poor understanding of the prior chapters on probability. This is critical for fix because the last two chapters often make up 50% of the final examination. In-process feedback gathered from the current group also revealed similar responses.

Discussions with lecturers who have taught the course contributed the following findings. Students often prefer to sit and work in group with their own friends; this does not facilitate effective learning as quite often the weak students are in the same groups formed by themselves. Although the group assignment (20%) is intended to promote cooperative learning within groups, some common issues hinder its objective. Among those are: lack of participation from each member, often resulting in only one or two members completing the bulk of the work, and also last minute compilation of isolated work pieces just before the submission deadline. The individual student's poor understanding is only revealed when grading their mid-semester test (25%). It is vital to detect such students much earlier in the process or best to strategize group work and activities in order to maximize participation.

2.2. The new approach

Based on prior teaching experiences and students feedback gathered during previous semesters, the following approach was developed and implemented on a group of students during semester A142. "Attitude matters most" is a common saying and student attitudes towards a subject lead to academic success (Popham, 2005). First and foremost, students' attitudes were worked on by resetting their mindset and belief system. Short inspiring stories or motivational quotes were shared at the beginning of lessons. Learning objectives by each chapter were emphasized to all students for preparation and monitoring. Facebook group was created upon students' agreement to facilitate timely communication concerning the course. Statistics was repackaged in a form of story-telling: begin with real life applications that students can relate to. For instance, M&M's games of throw/catch and counting within each team managed to demonstrate the basic probability concepts as well as the descriptive statistics, while relating to sample representativeness in statistical inference.

The guiding principles in redesigning the course conduct follows three standards (Cobb, 1992) recommended by the American Statistical Association (ASA) and the Mathematical Association of America (MAA): (i) emphasize statistical thinking (ii) more data and concepts; less theory, fewer recipes and (iii) foster active learning. The course promotes students to explore data and discover statistical ideas and draw inferences from the data by experiences they received in group discussions and activities. Aligned with Malaysia's CAPs and NKRA, the use of technology such as web tool 2.0 (Embi, 2011) in teaching and learning of this course was implemented.

Constructive alignment (Biggs, 1999) and student-centred learning through in-class explorations and discussions were also considered. Students construct meaning from what they do to learn and instructor aligns the planned activities and assessments with the intended learning outcomes. Students learn a specific topic via web 2.0 tools as appropriate to have better understanding on that topic. They are

encouraged to explore data and discover statistical ideas and draw inferences from the data by experiences they received in group discussions and activities.

A pre-assessment test consisting of eight multiple choice questions on basic algebra was given to the students on week 1. The results were used to form teams of four comprising a student with lowest mark, one with the highest mark and another two in the middle. The weaker was paired with the stronger as twins, and similarly for the other two with average marks. Twins were briefed on their roles and responsibility to learn and discuss among them. Team members sat together in class and the leader of each team was empowered to ensure full participation of members; any problems must be escalated to the lecturer timely. At the end of the course, team leaders were to complete evaluation for each member.

A list of formulae was provided to students and referred to as their “best friend” to psychologically de-alienate the often-feared symbols. While learning each topic, the relevant formula was introduced with emphasis on its meaning. Interpretation of values was emphasized instead of just the calculation part. Adding meaning to symbols and values does simplify learning. The various chapters were consistently linked-up to each other and were related to real applications. Examples of Statistics in practical applications such as Hans Roslings’ youtube videos and info-graphics were shared on facebook. Students were encouraged to share statistics around them randomly in class or on facebook group. Some good videos on basic probability such as Venn diagram from the website of patrickjmt.com were helpful for student revision.

In the past, a group assignment (20%) was given with submission deadline before the end of semester. This did not promote timely assessment and feedback to students. The new approach attempts to facilitate students learning by working together throughout the entire process. The group assignment was split into two parts (2 x 10%): both submitted before the mid-semester test. The assignments were submitted in soft copies, marked, commented and made available to all students; this promotes students to learn from everyone’s mistakes and keep improving. Some common mistakes and key learnings were discussed either on facebook group or during class. To address the issues of “copy and paste” among students, the assignments required real data collection within the class and each team investigates different variables. Use of an important tool, Microsoft Excel was made mandatory to promote analysis and presentation of real data, as well as to equip them with the commonly sought after skills at work.

2.3. Results of implementation

Based on students’ feedback, the assigned team and twin structure worked well. Story telling of statistics in practice exposed them to the big picture, enable relation to daily life. They appreciated the timely grading and feedback of results for quizzes, test and assignments which was effective for their learning process. Split group assignments allowed ample time for recovery and improvement as their submission dates were timely to intercept mid-semester test. Sharing of marked soft copies promoted learning and competition among teams. Games engaged and facilitated learning and deeper understanding of the topics, while online videos assisted understanding of some topics. Facebook group improved participation among students, and anonymous online feedback mechanism via padlet.com gathered honest opinions/comments for continual improvement. Use of Microsoft Excel in recording students marks enabled progress tracking, and timely identification of potential failures for remedial process. Students were rewarded for progress and achievement by giving them tokens during class or acknowledgement via facebook group. “Focus! Think! Refocus! Rethink! Practice! Practice! Practice!” was like a mantra in the class. Strong teamwork was evident among them as they cared for each other’s learning.

This new approach was well received by the students and their final examination results were very encouraging. None of them gave up on any of the questions especially the feared last two chapters; the two students (3%) who failed the course managed to obtain more than 40% in overall marks.

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