



# THE IMPACT OF TEACHING METHOD ON PERFORMANCE IN TEACHING MATHEMATICS AT TERTIARY LEVEL

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## ABSTRACT

The study seeks to explore different modes of teaching mathematics to students studying in a second language, and the effects of the varying approaches on student outcomes such as educational achievement and confidence in learning mathematics. Two case studies were used to examine the effectiveness of using worked examples versus the problem-solving approach for teaching mathematics to ESL students.

### Introduction:

In This case, study involves a subject called Math132 at King Abdul-Aziz University (KAU), Jeddah, Saudi Arabia. The design of the study was the same with a baseline data collection, followed by an intervention with the same mix of topics taught by problem-solving and worked examples in Implementation 1. Following the first implementation the method of teaching assigned to topics was swapped and a third method, namely faded worked examples replaced one topic previously taught with problem-solving and one previously taught with worked examples.

### Background of the study:

In this case, study, the students are studying at the King Abdul-Aziz University in Jeddah and the selection of this case is inspired by the recent focus on education in the Kingdom of Saudi Arabia.

The Kingdom of Saudi Arabia is emerging as an international heavy-weight, as it is wealthy, with a young and promising population (). The Saudi vision for the future requires a well-educated and highly informed citizenry to provide leaders and professionals capable of bringing Saudi Arabia to the global forefront. This is the basis for the significant changes to educational policy ().

Changes to the educational system in the Kingdom of Saudi Arabia have been profound moving from a long established approach to one that is relatively new and challenging given previous tradition.

This case study is inspired by the recent focus on education and surge in educational achievement over the last 20 years in the Kingdom of Saudi Arabia, which can be partially attributed to the pedagogical change in learning from traditional rote learning to explorative, and experienced based learning. Of particular interest as a case study is the change in the language of instruction from Arabic to English that has occurred in some secondary schools and all tertiary institutions in 2008, across the country including King Abdul-Aziz University.

With an increased number of educators training abroad, and foreign nationals teaching in Saudi schools, and universities, new practices and pedagogical approaches are beginning to make their way into the classrooms. However, the overzealous adoption of Western educational practices sometimes results in local Saudi teachers feeling marginalized and resentful (Elyas, 2010). To overcome such negative undercurrents, and to reinstate a sense of uniqueness and empowerment to Saudi teachers, a mix of teachers was sought, including some who have studied abroad (Al-Mohanna, 2010).

### Subject chosen, Math132

The subject used to test teaching innovations in this study was Math132. It is offered to undergraduate students through the Mathematics Department at the University of King Abdul-Aziz. Math132 was chosen, Math132 is a core requirement for all students who enter the Science Faculty. The subject is designed to give students basic mathematical knowledge, especially students who are interested in continuing their career or study path in mathematics. Math132 is structured so as to have one block of three hours per week in total class

time. Two hours for a lecture, and a one-hour tutorial in each block. The subject is divided into six areas sequenced over thirteen weeks as follows: functions, exponents, quadratic equations, logarithms, geometry and introduction to statistics. Teaching weeks are followed by one week of study recess and one week for examinations. The students who take this subject come from various levels of mathematical backgrounds. Following the policy of the university the Arabic speaking students are taught mathematics in English.

### Participants

A total number of 198 students, enrolled in Math132 over three implementations, were involved in this study. Virtually all students were studying in their second language, English. In terms of the study it was important that students were matched on key factors that could affect performance outcomes. The three cohorts were close in terms of size ranging from 64-68 students. Approximately 98 percent are from an Arabic background and approximately 95 percent of the students are domestic students, again with each cohort similar on these factors. Due to the segregated culture of Saudi Arabia and that male and females are taught in separate campuses, no female students were selected to be a part of this study. The students that participated in the study came from varying high school strands with 61 percent from Mathematics, 25 percent from Science and 10 percent from Arts for example for 2011; with a similar proportion in each year. Furthermore, in 2012, approximately 40 percent have learned their mathematics in English since Year 11 and 37 percent since Year 12, again with similar proportions in each data collection.

### Impact of changing teaching approaches on performance

To examine the impact of the teaching method changing is complicated. The process of the examination is as follows:

1. The first step involves gaining a sense of the design clarifying the means and standard deviations (refer Table 1.1) associated with each of the teaching techniques and topics followed by a formal examination of differences between means. This provides for easy reference in the subsequent discussion of results. Table summarises the results obtained from each topic test where the maximum mark was ten. The coloured rows indicate the teaching method associated with the topic in the three cohorts. The highest observed mean across cohorts for topics *Functions*, *Quadratic Equations*, and *Logarithms* were attained where the teaching method was WE. *Exponents* was the only topic which used PS method and obtained the highest observed mean. For topics *Geometry* and *Introduction to Statistics*, the highest observed mean was obtained when the teaching method was FWE.

Table 1.1 Final topic mean marks KAU 2010-2012

Topic	Year	N	Mean	S.D
Function	2010	66	6.08	2.433
	2011	68	8.06	1.370
	2012	64	4.52	2.330
Exponents	2010	66	6.82	2.067
	2011	68	8.34	1.334
	2012	64	5.80	2.457
Quadratic Equations	2010	66	4.85	2.579
	2011	68	8.81	1.069
	2012	64	5.39	2.524
Logarithms	2010	66	6.41	2.280
	2011	68	3.07	1.568
	2012	64	7.92	1.546
Geometry	2010	66	5.77	2.630
	2011	68	3.04	1.670
	2012	64	8.00	1.392
Introduction to Statistics	2010	66	6.68	2.432
	2011	68	2.63	1.647
	2012	64	7.22	1.759

Traditional	WE	PS	FWE
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The movement of the topic means from year to year (shown by non-parallel lines) suggests that there will be an interaction between year (that is the different teaching methods) and topic. This will be examined more closely in the next step of the analysis.

The below plot of the same topic means. This time showing the topics on the horizontal axis is given Figure 1.1. This plot emphasizes the different movement of the topic means for 2011 compared to 2010 and 2012.

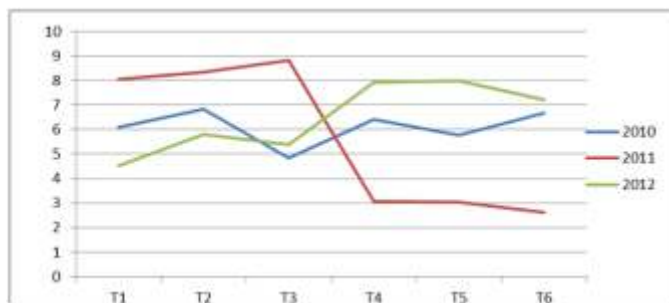


Figure 1.1 Means of topics for KAU over years 2010-2012

- The first analysis has six dependent variables (T1 to T6), the marks (zero lowest -10 highest) on each of the six topic tests, and year (2010, 2011, and 2012) as the proxy independent variable. In different years, different teaching methods were used for different topics allowing an examination of the impact of teaching method on topic marks. As the topic tests are given to the same students, the means derived from the same students are measured on each topic, and used to examine whether there is an interaction between year and topic. This initial analysis was carried out using a Repeated Measures ANOVA, with the first step an examination of assumptions and the second an examination of the multivariate tests.

**Conclusion:**

This study indicated that the language of teaching mathematics has impacted on students learning if they learn in their second language. For example, 66 percent perceiving their ability to be fair/very good in 2010, when they come to indicate their ability to learn mathematics in English, this percentage has declined to two percent of students in 2012. This difference is significantly different. Moreover, 148 students (75%) rated their general mathematics ability higher than their ability to learn mathematics in English (n=50, 25%). Therefore, using worked examples would be preferable in term of lowering cognitive load with reference to the language barrier and difficulty of mathe-

tics than using problem-solving and faded worked examples. This may explain that over the three phases a greater proportion of students indicated that having worked examples improved their worked examples than did problem-solving and faded worked examples.

The aim of any tertiary studies is to prepare students to have the ability to solve their own problems, so there is a need to build students' confidence through the teaching and learning process. As it has been clearly seen through this study, students love to learn mathematics with worked examples but it did not help them to become more confident in their mathematics. In the first Implementation, it appeared from student comments that students were more confident when using problem-solving approaches. As a consequence the researcher suggested the use of faded worked examples produced better results than problem-solving and worked examples, further work is needed to explore the impact of faded worked examples on confidence.

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