Stats for the Terrified: Impact of Different Teaching & Learning Approaches in the Study of Business Statistics

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Abstract

Many students have a fear of studying Statistics & Mathematics. The objective of this study is to highlight the methods that could help students to improve the learning of Business Statistics. This paper could also provide a useful input for teachers who can benefit from knowing what methods improve student learning of Business Statistics based on the personal background of students (for e.g. whether they had studied Statistics before, whether they use Statistics in their jobs etc.) and their preferences.

This research work also documents the comparison of how teaching and learning methods differ in reality and in preference when students had studied statistics in past and when they had not attended any course of Statistics in the past. The empirical analysis in this research is based on the data collected from 81 correspondents who are registered in a part time course in MBA or in MA (HRM).

Keywords: Statistics education, Teaching methods, Anxiety

1. Introduction

Mathematics and statistics are widely recognised as two of the most important subjects in the university curriculum (Orton, 1987). It is commonly believed that customary methods of teaching statistics to students are not very effective (Yilmaz 1996).

Statistics as a discipline is an offshoot of Mathematics and has existed for many centuries. In schools and in universities it continues to be one of the subjects which are often considered to be difficult by students who try to avoid it. Statistical concepts are sometimes complex, abstract and involve laborious computations.

Drawing on Ramsden (1992), the paper argues for an approach to teaching and learning statistics in ways that are linked to students' experiences of the world is more tractable to many students (see also, Peiris and Peseta (2004)). There are umpteen numbers of factors affecting performance level of students in Statistics. An important factor that seems to be important is anxiety. Many research studies show that anxiety affect performance (e.g., Leon & Revelle, 1985; MacLeod & Donnellan, 1993; Sorg & Whitney, 1992).

Miller and Bichsel (2004) surveyed 100 adults that varied in age (18-66) and education levels (high school degrees to college graduates). The participants were tested for 1-2 hours on five measures: math performance, math anxiety, state-trait anxiety (state anxiety can vary over time and in different situations but trait anxiety is relatively stable), verbal working memory, and visual working memory. Math anxiety was determined to be the most important factor in predicting both basic and applied math performance. After math anxiety, both verbal and visual working memories were important in predicting basic and applied math performance. Math anxiety appeared to be predictive of females' performance in both basic and applied mathematics but math anxiety affected males more than females in basic math and was not significant for males in applied mathematics.

A more representative study of math anxiety was reported by Ma & Xu (2004). These researchers performed structural equation modelling on data from the nationally-representative Longitudinal Study of American Youth to sort out the causal ordering of math anxiety and math achievement. Low math achievement was related to subsequently higher levels of math anxiety. As with Haynes, Mullins & Stein (2004), Ma & Xu found no significant effects of gender on this causal ordering.

2. Methodology

The data for this study was gathered through a single questionnaire distributed to two different sets of respondents at the Bristol Business School, University of the West of England. First set being the Masters level students of Human

Resource Management and the second set included the part-time MBA students. Majority of the students are White British. I am the course teacher of Business Statistics to both of these groups of students. All of the students from both the groupings were experienced and were working in the corporate world with varied specialisms. Majority of those students can be termed as non-statisticians due to the lack of any formal degree involving deep use of Statistics or Mathematics.

A simple questionnaire was used to collect data from MA (HRM) students (n=54) and MBA students (n=17). This makes 81 respondents in total. The questionnaire was distributed and collected during the third of the five normal class-room sessions. I preferred the use of questionnaire over other means of collecting data as it is an inexpensive way to gather data from a potentially large number of respondents. According to Oppenheim (1992) and Sapsford (1999), questionnaires offer an objective means of collecting information about people's knowledge, beliefs, attitudes, and behaviour.

To validate the questionnaire I developed it with continuous suggestions and feedbacks from three experienced academicians. Two of these academics had education background whereas the third one had a business management background. This helped me cross-review the questions in the questionnaire. This practice was in line with the one propagated by Boynton & Greenhalgh (2004). According to whom, sometimes a questionnaire will be appropriate only if used within a mixed methodology study—for example, to extend and quantify the findings of an initial exploratory phase.

I taught the following basic topics to the students in both the groups:

Tabulations, diagrammatic methods and numerical methods such as a histogram, a bar chart, a pie chart, numerical distributions; measures of central tendency viz. mean, median, mode; measures of dispersion viz. standard deviation, range, variance and coefficient of determination; regression and correlation. I taught them the use of formula for each of the above and then solving the problems using MS Excel.

MA (HRM) students were assessed based on an assignment whereas MBA students had to sit for an open book examination.

2.1 Results of the Survey

52% of the respondents were female and 48% male in the MBA group and in the MA (HRM) group 89% of respondents were female, and 11% male. Overall 70% of the respondents of the total of 81 respondents were female, and 30% male.

Have you studied Maths or Statistics before?

	Yes	No
MBA	88	12
MA(HRM)	94	6

Exhibit 1

Level at which Maths or Statistics studied before by MBA students

Level	None at all	GCSE	A level	Other
%	12%	30%	12%	46%

Exhibit 2

Level at which Maths or Statistics studied before by MA (HRM) students

Level	None at all	GCSE	A level	Other
%	6%	65%	17%	12%

Exhibit 3

Having studied Statistics or Maths at other level could mean either studying it at undergraduate or at postgraduate studies as a minor or ancillary subject.

There were 17% MBA students and 9% MA (HRM) students who marked having studied Statistics at both GCSE and other level. In the tables above I have counted such students under the GCSE category. None of the students in both the groups had studied Maths or Statistics as a major subject for either undergraduate or postgraduate degrees.

Exhibit 4 & 5 show the mean scores to the questions on the scale of 1 to 5.

MBA (n=17)	1	2	3	4	5
	Very Much	Much	Neutral	Not Much	Not at all
How much has your work already involved dealing with Statistics?	0	29.41	11.76	35.29	23.53
How much do you like working with numbers?	17.65	47.06	29.41	5.88	0
When you started this Business Statistics course how anxious were you about doing Statistics?	17.65	5.88	41.18	17.65	17.65
Now you have reached the third session how anxious are you about doing Business Statistics?	23.53	41.18	11.76	11.76	11.76

Exhibit 4

MA(HRM) (n=54)	1	2	3	4	5
	Very Much	Much	Neutral	Not Much	Not at all
How much has your work already involved dealing with Statistics?	0	24.07	16.67	46.30	12.96
How much do you like working with numbers?	1.85	18.52	24.07	44.44	11.11
When you started this Business Statistics course how anxious were you about doing Statistics?	18.52	38.89	18.52	16.67	7.41
Now you have reached the third session how anxious are you about doing Business Statistics?	5.56	22.22	38.89	22.22	11.11

Exhibit 5

Comparing exhibits 4 and 5 one can see that none of the students in the two groups had their work involve dealing very much with Statistics.

MBA students seem to like working with numbers when compared with the MA students. As the combined of very much and much categories for MBA students stand at 65% while the same figure for MA students is 20%. The most probable reason for this could be the fact that their work involved dealing with numbers more than the MA students.

MA(HRM) (38.89%) students were much more anxious than the MBA students (5.88%) when they started with this course.

The anxiety level of MBA students (23.53+41.18=64.71%) is more than the MA students (5.56+22.22= 27.78%) on reaching the third session. This is in contrast with what they stated at the start of the course. There could be many reasons for this level of anxiety. One could be the fact that MBA students are assessed in form of an examination whereas the MA students are required to submit a home assignment for which they have a lot of time and could take help of others.

2.2 Preferred Methods

Following are the results in percentages of the preferred methods that students find most and least helpful for the teaching and learning requirements of Business Statistics on a scale of one to five. One being least helpful and five being most helpful. I have two different tables, one for MA (HRM) students and the other for MBA students so as to be able to compare the preferences of students. Exhibit 6 & 7 show the mean scores to the questions on the scale of 1 to 5.

5= Most Helpful

1= Least Helpful

MBA (n=17)	1	2	3	4	5
Peer work or discussion	0.00	11.76	29.41	41.18	17.65
Tuitions: going to external help	0.00	15.38	61.54	23.08	0.00
Computers (MS Excel, Internet etc.)	17.65	23.53	35.29	17.65	5.88
Further readings from text books	0.00	23.53	11.76	58.82	5.88
Class-room teachings	5.88	11.76	58.82	11.76	11.76
Exercises given during the class	0.00	29.41	11.76	29.41	29.41
Home work	0.00	0.00	50.00	33.33	16.67
Library Resources	10.00	20.00	70.00	0.00	0.00
Examples based on real life	0.00	8.33	0.00	66.67	25.00

Exhibit 6

MA(HRM) (n=54)	1	2	3	4	5
Peer work or discussion	0.00	7.55	28.30	47.17	16.98
Tuitions: going to external help	7.14	21.43	46.43	17.86	7.14
Computers (MS Excel, Internet etc.)	2.94	14.71	44.12	26.47	11.76
Further readings from text books	6.12	4.08	40.82	38.78	10.20
Class-room teachings	0.00	5.77	17.31	50.00	26.92
Exercises given during the class	1.92	1.92	17.31	55.77	23.08
Home work	6.82	22.73	52.27	15.91	2.27
Library Resources	6.82	18.18	56.82	11.36	6.82
Examples based on real life	1.92	3.85	17.31	53.85	23.08

Exhibit 7

Exhibit 6 and 7 provide some very interesting observations about the nature of the two groups. These exhibits provide some useful data which could be used by teachers for improving their teaching methods. Although the exhibits also reflect the inherent deficiencies in students that could help them improve their Statistical prowess.

41.18% of MBA and 47.17% of MA students found peer work or discussion to be a useful tool. I often gave students breaks to discuss in couples select topics I had covered during the lecture. Students also suggested that doing exercises in groups is also helpful for them.

Going to external help in for of tuitions met with a lukewarm response with most of the students in both the groups choosing to be neutral on this topic.

What is very interesting to find that not as many students in both the groups find the use of computers in solving problems very helpful. Only 38.23% (combined 4 & 5) of MA students find it useful as opposed to 23.53% (combined 4 & 5) of MBA students finding it useful.

MBA (58.82+5.88=64.7%) students find further readings from text books being helpful in contrast with the MA students who do not find it to be very helpful (38.78+10.20=40%~).

MBA students did not find class-room teachings to be very useful (11.76+11.76=23.52%). 58.82% of them chose to be neutral on this. Although 76.92% (50+26.92) of MA students find it helpful.

78.85% (combined 4 & 5) of MA students and 58.82% (combined 4 & 5) of the MBA students find exercises given during the class to be helpful and

50% of MBA and 52.27% of MA students chose to be neutral about the helpfulness of home work. Arguably, this also reflects the less interest among students to spend time on self-learning and practicing Statistics. This in my opinion is a big problem. Similarly, 70% of MBA and 56.82% of MA students chose to be neutral about the helpfulness of library resources. The UWE library has sufficient textbooks of Statistics. This also reflects, perhaps, the fact that not many students prefer spending time in Library.

Both the groups seem to be unanimous about the helpfulness of the examples based on real life. 91.67% of the MBA students and 76.93% of MA (HRM) students find such examples to be helpful to their learning needs. Also, MA(HRM) students seem to be more interested in doing the examples particularly from the Human Resources field instead of the ones from the general business management field. This posed to me a good challenge as I had to find specific Human Resources oriented examples or convert already available examples into the same.

Following three open-ended questions asked in the survey provide some insight into students' preferences and difficulties towards the methods used in the class room:

(1) If you have studied Maths or Statistics before what other methods have you found most helpful? (Please state)

Relating real life examples with concepts

Plenty of exercises

Working through examples as a group and then having a go at another example yourself

Use of MS Excel is more practical to analyse data instead of using formulas

Examples with answers in printed format so that they can work through at their own pace outside class

Alternative approaches to learn correlation and regression was helpful

Applying stats to simple household things was interesting.

Use of case studies

Exercises in class is probably the best method and also good for revising a concept

Computer programmes help

(2) What in your opinion are the strengths and weaknesses of the current ways of teaching Business Statistics?

It is good to explain the following at the outset of the course:

Why statistics is used?

Why we are doing it and what the end result is?

Where does the formula come from?

Not many practical examples

Need clear linkages between the formulae

More examples in class

More active teaching and inclusion of students

Short period of time to cover a range of concepts

Some simple example first would help before diving straight into a complicated example

Need to start with some very basic examples and not assume complete knowledge of some complex equations and formula

Do not need to use slides which are not going to be used

Would be better to give handout of core concepts then told to support slides by reading book

Relate backwards from real examples before going into theory

Need to spend more time building up to new ideas and equations.

Too fast

Examples had too large numbers involved to explain concepts. Unnecessarily complicated examples used to explain concepts

A little rushed

Tutor is happy to go over subject

Not enough exercises homework to test our understanding

Clear PowerPoint slides

Teacher doesn't assume previous knowledge

Can ask questions and get points clarified

Going at a steady pace

Doing exercises to test students understand when to read on through the handout to get the answers

Not having a clear timetable as to when we will be doing the IT sessions

Patience, repetition, encouragement

Students need two clear examples for each new thing to ensure understanding

Handouts are good

It gets complicated quickly

Methodical, lots of details, goes through the topics step by step which is very useful

Well presented and explained but limited time for topics

Something seem to be explained in an overcomplicated way

Teacher is helpful and supportive

Formulas are very confusing

Useful in decision making

Not applicable to work situations

Too long is given for peer discussions and the conversation moves away from Statistics

Good slides

Use of Statistical jargons is confusing

(3) What in your opinion could be done to improve teaching and learning of Business Statistics?

More hours, exercises, mock tests with exam-like questions, derivation and meaning of each component of any statistical formula, detailed explanation of concepts

More focus on explanations of theories and how/why they can be used in real life

Homework to reinforce learning

Make it easier to understand

Easier to apply in real life

Worked examples on board as a group followed by individual practice

Breaking groups into smaller ones to solve problems help support each others understanding during the process

Would help to split groups as some people are far too advanced than others

More time should be given to interact with others about how to solve the problems

Teachers must go through examples more thoroughly and allow less time to discuss with colleagues. Some time may have been wasted using this method.

Give choice to students who are at a higher level of understanding, otherwise it would be a waste of time for them

Identify what specifically we are to cover at the beginning of each day and summarise. Check off at end to confirm class is happy that methods and formula etc are understood & accepted

An appreciation that there are different levels of ability in class

Need to slow down slightly

Give more examples of exam questions/ assignment questions

Explain what the exam would cover

Revision of past paper questions

Revision of basic concepts or stress this as preparation for course

Make sure guidelines for assignment are clearer

Explain the topic and its relevance to the present and future roles of students as managers

More MS-Excel work early in the course, e.g. teaching one week and excel next week and so on

Have a workbook without the answers to test our understanding and once we have completed the exercises handout the answers

If the module was run next to the first modules it would have more relevance

Need for more relevant examples

3. Recommendations

It is better to organize class and computer sessions alternatively instead of doing all the classes first and then doing all the computer sessions. This gives students an opportunity to practice on computer immediately after their class-room teaching.

Some students might need some extra support and clarification. The teacher must try to help such individuals as they are more likely to complain to the deans and programme managers about what not has been done right by the teacher.

Students are prejudiced with numbers based on their previous experiences leading to anxiety. Having students in large classes further complicates the situation who are already weak in Maths/ Statistics and are often reluctant to study and pose challenge to the teacher. Teachers should also realise that teaching Statistics to non specialists is a completely different ball game requiring some special preparations. For example, some students can have problem with understanding Greek symbols and also would like to know where the formula comes from and so on.

Every aspect of teaching needs to be adapted for teaching non-specialists; the method used, examples, the assessment criteria, time-line, and use of computers and so on. Treating non-statisticians students as statisticians could lead to a catastrophe.

4. Discussion

The results of this study indicate that both the groups of students displayed a high level of anxiety. Following are my observations based on the questionnaire and my personal experiences which lead to anxiety among the teacher and the taught and some practical suggestions:

(1) Most often there are two types of students in a group. One who know some Statistics and the other who do not. If one satisfies the first lot the second lot is not satisfied and vice versa. It is never easy to strike the balance. In both the situations teacher is bound to lose face and is at the receiving end.

(2) Most students do not do self reading from books. What one teaches in class room has to be complemented with a lot of self reading. In 8 or 10 hours of teaching they will not become Gurus of Statistics.

(3) Statistics is abstract. To learn application is only possible once you learn the concept. The concept in itself is abstract. One can't teach 100% of application of concepts to the students who do not know the concepts in the first place.

(4) Anxiety and frustration is and it is not students fault. It is because of point 2 above and it is not because of point 3 above.

(5) It is because of the anxiety and a fear of self that students try to externalise a problem for which actually the solution lies within. They may have assignment deadlines and they could be under pressure.

(6) Many students want teachers to spoon feed and explain the same thing over and again (because sometimes some of them have been chatting when a teacher is explaining something).

(7) Sometimes they are confused and want teacher to answer their questions. Sometimes teachers should not answer all the questions, because confusion is curiosity which leads individuals to read and find out the truth. This could be taken by students as being unhelpful on the teacher's part.

(8) Also a teacher may not want to answer their direct questions related to the assignment as answering amounts to solving the questions which in turn amounts to giving 100% marks to all of them

(9) The handouts and support material teachers generally give are imperfect because what works for some doesn't for others. They are just general points of reference and help.

The trick is in the subject which invites criticism of the subject and its teachers in abundance without realising the fact that the subject is a goldmine.

5. Limitations

This research study is completely based on the responses and therefore preferences of students. It is sometimes true that the students are not aware of what method of study is good for them and what is not especially when most of the students had no or little exposure to statistics in the past.

I don't foresee any major ethical dilemma in this research work. There is a minor ethical dilemma as the students are evaluating my teaching style and in order to reduce this dilemma all the questionnaires were kept completely anonymous.

I had asked MA (HRM) students about the helpfulness of using computers before having conducted any computer-oriented exercise sessions. So I relied on their past experiences of having used computers for solving Statistical problems.

6. Summary and Conclusions

This article provides a snapshot of helpfulness of different methods in the teaching and study of business statistics. The two focus groups constituted mostly part-time students who were working and can be classed as non-statisticians. The results show that anxiety levels were high among students and students prefer to learn when the teacher uses many examples based on the real life business situations. They tend to spend less-time on self reading and using library resources. Anxiety could be reduced by way of giving simple and pertinent examples in the class, clearly laying down the objectives of the course and also the objectives of each session, clearly defined assessment criteria and expectations to pass the course. Overall, this piece of research might help students and teachers alike to realise the extent of helpfulness of different teaching methods used.

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