

A Discussion of different teaching strategies adopted during a Statistics tutorial

Vasos Pavlika, B.Sc M.Sc PGCE Ph.D C.Math FIMA CPhys CSci MInstP CITP MBCS FIAP
MIET MIEE Senior Lecturer, Information and Software Systems Department, University of Westminster,
Harrow, Middlesex, United Kingdom V.L.Pavlika@wmin.ac.uk

Abstract

In this discusses four different approaches used during a statistics tutorial of a group of first year undergraduates studying computer science related degrees at the University of Westminster UK. The four approaches were each implemented in an attempt to keep the students interested in the statistics topics delivered. It was found that “Chalk and Talk” (i.e. board work) was not the best form of imparting knowledge to the students of the group as determined by student analysing feedback forms and generally observing student behaviour and listening to student comments over a number of years delivering statistics topics. The duration of each tutorial was two hours.

The teaching strategies adopted were:

- a) A class quiz.
- b) Group explanation of material to members of the individual’s group.
- c) Group explanation of material to members of the entire class.
- d) Students teaching at the front of the class.

Each of the methods will now be discussed with the relative merits and defects included for a comparison. It was found that each method worked better at the end of each module when the students were more familiar with the topics introduced on the module.

Introduction

This part of the paper discusses the teaching methods that were used in the session. The rationale for choosing the methods came from observations over many years of classes delivered by the author. It became clear that certain characteristics permeated each tutorial, these were

- i) who students preferred to sit with
- ii) students insistence on wanting a break at the end of the first hour of a two hour tutorial session
- iii) noise level increasing later in the course, this may be due to the students becoming familiar with each other and more comfortable with the tutor. Further research into causes of this are a subject of future research.

Class Quiz

In order to determine members of each group the author nominated four so-called captains and each captain took it in turns to choose a member for his/her group. To determine which captain started first a coin was tossed. During the tutorials it was found that there were at most four groups with four members in each group.

Once the groups were determined each group had to prepare two questions for each of the other groups to pose them as exercises. The questions could be taken from the class notes or any of the recommended text books of the module. Both the *Posing Team* (the team setting the questions) and the *Attempting Team* (the team answering the questions) were permitted to use the class notes. The scoring for the quiz was as follows:

Rules of the Quiz

- If the posing team could solve the particular problem they were awarded one mark.
- If the team attempting the question could also solve the problem then the Attempting Team was awarded one point (the Posing Team was still awarded one point).
- If the team attempting the question could not solve the problem then the Posing Team was awarded two points and the Attempting Team no points.
- For a question to be allowed, the posing team had to be able to solve the question set, this was determined before the quiz began by the author.

Below is an actual set of questions set by a particular team with the respective scoring also shown.

Question 1

The weight of a sample of patients being treated were measured and found to be:
103, 127, 96, 110, 115, 72, 97, 134.

- i) Find the sample mean and standard deviation
- ii) Find a 95% confidence for the mean μ
- iii) Find a 90% confidence for the mean μ
- iv) Compare the widths of these intervals
- v) Do the confidence intervals of ii) and iii) contain the value 100?

Question 2

The scores for three tests undertaken by a year 5 group are presented in the table below:

	Test 1 (score out of 20)	Test 2 (score out of 50)	Test 3 (score out of 100)
Lowest score	5	12	20

Highest score	19	43	75
Lower quartile	9	19	35
Upper quartile	15	35	70

Which of the following statements are true?

- a) The highest and lowest marks for the year group declined over the three tests
- b) There was no change in the year group's performance over the three tests
- c) Marks for the year group improved over the three tests.

Convert the results into percentages, and draw Box and whisker diagrams on the same scale to compare the tests.

Question 3

Using the Normal Distribution solver found at

http://davidmlane.com/hyperstat/z_table.html, solve the following:

The mean mass of 500 male students at a college is 68.6 kg and the standard deviation is 6.8kg. Assuming that the masses are normally distributed, estimate how many students have a mass

- a) between 54.5kg and 70.5kg
- b) more than 84 kg

Question 4

Derive from first principles the ordinary least square coefficients given by:

$$a_0 = \frac{(\sum y)(\sum x^2) - (\sum x)(\sum xy)}{N(\sum x^2) - (\sum x)^2}; a_1 = \frac{N(\sum xy) - (\sum x)(\sum y)}{N(\sum x^2) - (\sum x)^2}$$

it was noticed in this question that the students relied heavily on Spiegel [7] to state the required formulae which was permitted by the author for this question.

Question 5

Find the least square line for the following data:

Height x	70	63	72	60	66	70	74	65	62	67	65	68
Weight y	155	150	180	135	156	168	178	160	132	145	139	152

Question 6

Prove that

$$s = \sqrt{\frac{\sum x^2}{N} - \left(\frac{\sum x}{N}\right)^2} = \sqrt{x^2 - \bar{x}^2}$$

where symbols have their usual meanings. Again it was noticed that the students referred to one of the course text books to state this result, namely Clarke [3] but this was again permitted by the author. It was found that this method of learning was immensely popular with the students instilling a sense of teamwork. The author had to ensure that student enthusiasm during the competitions was within an acceptable level, as student debates became extremely animated. This method of learning allowed the author to determine the level of each team and to get “a feel” for what parts of the module the students found difficult as these were the questions that tended to be set by the Posing teams.

Sample Results

Below are a set of results conducted during an actual tutorial for teams labelled A, B, C and D. Team A was the Posing Team.

Posing Team A	Team A	Team B	Team C	Team D
Question 1	2	0		
Question 2	1	1		
Question 3	1		1	
Question 4	1		1	
Question 5	1			1
Question 6	2			0
Totals	8	1	2	1

For the sample results Team A was posing the questions and thus had the greatest total. Each team took turns to pose questions and the overall totals were determined.

Group Explanation of material to Members of the individuals group

Using this approach the author put the students into groups and asked members of the group to nominate another member of the same group to discuss and explain parts of the lecture that they had attended during the week or previous weeks. This worked well with the members of the group that were comfortable reporting back to their peers. The author went round to as many groups as possible during the session to listen to explanations given by individuals of each group.

Group explanation of material to members of the entire class

Using this approach members of a group explained a particular topic to the entire class, the students did not approach the front of the class but remained at their desks and a “joint” discussion of a particular mathematical topic was given. This turned out to be extremely fruitful as even the apparently weaker students were able to make a contribution during the feedback period.

Students teaching from the front of the class

Using this approach allowed for volunteers to come to the front of the class to deliver/explain part of the previous lecture or lectures of previous weeks to the remainder of the class. This worked well with those students that were comfortable talking at the front of the class and of course with those students that were sufficiently competent/knowledgeable with the material delivered in the lecture. On no occasion was a student invited to the front of the class by the author, only students who wanted to come to the front did so. Topics that seemed to be popular were:

- discussions on the normal distribution.
- discussions on measures of dispersion.
- discussions on measures of central tendency.
- discussions on methods of presenting data.

Topics that were not popular and in which very few volunteers approached the front of the class were:

- discussions on other probability distributions
- discussions on OLS.
- discussions on skewness.
- discussions on moments.

Encouraging this style of teaching enabled the author to determine the level of those students that chose to report back to the group. Of course it also became clear which topics were the most challenging for the students, as already stated, for the unpopular topics, on some occasions there were no volunteers to report back to the group.

Discussions

Four methods of teaching have been discussed in this article. Each method had definite positive and negative aspects. These will be summarised below.

Class Quiz	Positives	Negatives
	Attempting Team worked well together to solve problems set.	The Setting Team generally had all questions set by the most able of the group, the less able students did not participate.
	Knowledge shared by members in both the Setting and Posing Teams.	Students occasionally wanted “Chalk and Talk” sessions from the lecturer especially when a new and difficult topic had been discussed in the previous lecturer. Thus students thought more specific learning took place during a “Chalk and Talk” session.
	Able to look over all module notes and thus continually revise material.	
Group explanation of material to members of the individual’s group	Positives	Negatives
	Reporters demonstrated their knowledge and enhanced their own as well as their colleagues knowledge.	The more reserved and shy students did not participate in this approach and were often left feeling left out.
	Knowledge shared by an able member of the team.	An exercise in which the more able students excel and the less able feel intimidated.

Group explanation of material to members of the entire class	Positives	Negatives
	Even less able students reported back to the class.	More dominant personalities overwhelmed the less outgoing

		members of the group.
	Knowledge shared by many members of the tutorial group.	Less able and shy students felt left out.

STUDENTS TEACHING AT THE FRONT OF THE CLASS	POSITIVES	NEGATIVES
	Able to determine the exact level of an individual member of the group.	Appropriate to only the outgoing members of the class.
	Knowledge shared predominantly by the most able student of the class to his/her peers.	Not many students volunteered to report back to the class from the front of the class, hence this teaching approach could not be used for the entire two hours.

Conclusions

In this article different teaching strategies utilised during tutorial sessions have been discussed. Due to the very nature of the approaches adopted no one approach was exclusively used during any particular session. It was found that in most cases:

- 1) Group explanation of material to members of the individual's group
- 2) Group explanation of material to members of the entire class.

could be combined in a tutorial session and was found to work well. *The Class Quiz* could be used for the entire two hours. The method of *Students teaching from the front of the class* was generally adopted to implement a different teaching strategy in the tutorial and to break up routine, especially during sessions in which students attempted questions individually at their desks. Other approaches to teaching in tutorials sessions are now being considered by the author and is area of considerable research in the education sector. These techniques include (but not exhaustively) the following:

- i) mini-lecture (lasting about fifteen minutes) followed by student centered work
- ii) controlled group discussion in which a different statistical topic written on pieces of paper and placed in a sealed envelope by the are placed one on each desk, a small group of students on opening the envelope then discuss the topic on the card.
- iii) Buzz groups: a small statistical is given to each student group, typically to prepare a discussion to be given to the entire group on a statistical subject designated by the author.
- iv) Mini debates, this typically consisted of two groups uniting to oppose two other groups in the tutorial to debate which and when statistical tests were appropriate to use e.g. the student t-test versus the Normal Distribution.
- v) Student presentations, more confident and able students were asked (if they wanted to of course) to give a discourse von a particular statistical topic.

Many other teaching styles were used with a varying degree of success, these included: brainstorming, i.e. asking students to give their comprehension of a particular statistical concept in class feedback session and using formal and informal teaching styles as discussed in Gibbs [4]. It was found that the students much preferred an informal relaxed teaching atmosphere, class room management has been a previous research topic of the author as described in Pavlika [5] and the results ascertained further illustrate the methods discussed in that article.

Other interesting teaching strategies can be found in Ashcroft [1], Rogers [6] and Brown [2].

References

1. Ashcroft, K and Foreman-Peck, L (1994). *Managing Teaching and Learning in Further and Higher Education*, London, Falmer Press.
2. Brown Sally, and Race Phil., *Lecturing a Practical Guide*, (2002) London.
3. Clarke, G.M and Cooke D., *A Basic Course in Statistics 2nd Edition*. Edward Arnold.
4. Gibbs, Graham, Habershaw Sheila and Habershaw Trevor (1998), *53 interesting things to do in your seminars and tutorials*, Bristol.
5. Pavlika. V., *An investigation into how classroom management affects student output*” Published in the August edition of MSOR Connections, the newsletter of the Maths, Stats & OR Network, volume 7, No 3, August-October 2007.
6. Rogers, A., (1996). *Teaching Adults*, 2nd Edition, Buckingham, Open University Press.
7. Spiegel, M (1961). *Theory and problems of Statistics*, Schaum's Outline Series, McGraw Hill Book Company.