

NOVICE EXPERIENCE FROM TEACHING SERVICE COURSES IN STATISTICS

Matina J. Rassias

Department of Statistics, University of Glasgow, United Kingdom
s.rassias@stats.gla.ac.uk

The last few decades have been marked by a movement towards student centered teaching. This remains a real challenge for all educators but becomes even more demanding when dealing with service courses in Statistics. One of the main issues that statistical education has to face from the very early stages is introducing students into statistical thinking in the face of negative feelings such as discouragement and even frustration towards the subject area. In this paper we will study, from a novice educator's perspective, ways to enrich the students' learning processes transforming them into "intelligent citizens" who will communicate efficiently and effectively using Statistics. We will investigate how the educator can be assisted to become the facilitator in providing a highly stimulating and challenging environment in Statistics education that enables students to engage with the subject and make a smooth transition towards statistical literacy.

INTRODUCTION

The last few decades have been marked by a movement towards student centered teaching. This itself proves to be a real challenge. Educators are expected to listen to individual students voices, constantly adjusting practice to the arising student needs and expectations, without compromising the quality and standards indicated by higher education. The process becomes even more demanding when dealing with students whose major interest is not directly related to the discipline under consideration. Such is the situation related to service courses in Statistics.

"Why do we have to take Statistics?" is one of the most common questions addressed to the educator (Pollock & Wilson, 1976). Students frequently consider that their quantitative methods and statistics courses are more difficult than their major subjects (Basturk, 2005), reaching even the point of referring to the statistics course as "sadistics" (Rosenthal, 1992). The audience is reluctant to learn and unwilling to attend the lectures. In such cases it is highly difficult, even for the most experienced lecturers/teachers, to try to investigate and challenge these perceptions. Feelings of frustration, insecurity and rejection can naturally occur in these cases, as it is pointed out by Larrivee (2000). Yet from the very early stages, one of the main issues on which statistical education has been to focus is introducing students to ways of statistical thinking. Engaging students in these ways of thinking is critical to their ability to understand the relevance of statistics within their majors.

In this paper we will study from a novice lecturer's/teacher's perspective, ways to enrich the students' learning processes transforming them into "intelligent citizens" (Wild, Triggs & Pfannkuch, 1997) who will communicate efficiently and effectively using Statistics. We will also investigate how the educator can be assisted to become the facilitator in providing a highly stimulating and challenging environment in Statistics education that enables students to engage with the subject and make a smooth transition towards statistical literacy.

HOW TO CONTRIBUTE TOWARDS STUDENT ENGAGEMENT

Our teaching experience so far dictates that in order to face such issues the key approach is student engagement. In other words our primary goal is to try to engage the students during (or after) the lecture. Research on the topic of "engagement in higher education" has indicated that the most popular three words used to define engagement are 'interest', 'enjoyment' and 'interaction'. The most commonly cited constraints to effective engagement are the method or quality of teaching and a lack of student confidence. The above outcomes were obtained when: *Academic staff and students were surveyed using a web-based questionnaire*, in the University of Nottingham, (Charlton, Langmack, Peirce & Sach, 2004).

Context

Our teaching involvement in the University of Glasgow for this year has been focused in teaching service courses providing an Introduction to Statistics for: *Semester 1*: a 5 week Level 3 course for

the Faculty of Biomedical and Life Sciences (mainly Physiology and Sports Science) students and *Semester 2*: approximately 6 weeks of lectures for Statistics 1C which is a year-long large-scale Level 1 course required (mainly) from the Department of Psychology.

As it is noted on the courses' handout distributed to the students: "The emphasis throughout the courses is on the application of Statistics. It therefore concentrates on how to pose answerable questions, design an appropriate experiment or survey, apply sensible statistical procedures to the resulting data and, finally, interpret and report the answers to the questions posed on the basis of this analysis." The students are introduced to the statistical computing package MINITAB in order to analyse data without being potentially occupied with mathematical details.

Method

In order to face possible alienation, we constantly try to motivate the students and engage with them during, or after the lectures, applying the following practices.

1. *Trigger enthusiasm by providing lecture content as familiar as possible to their specialisation.* Choose, each time, a variety of examples in order to arouse the interest of the class majority. Students often have low motivation about introductory statistics courses, if they cannot see the direct relevance of the course to their own real interests (Wild, 1995; Basturk, 2005). We ought to have in mind that "teaching is not a matter of transmitting but of engaging students in active learning, building their knowledge in terms of what they already understand" (Biggs & So-Kum, 2007).

2. *Provide an "alert and vigilant" environment by frequent question/response surprises.* It is one of the lecturer's responsibilities to keep the students' interest vivid throughout the lecture. For the first year's practice, we chose to "surprise" the students by posing questions to the whole class. This can be a real challenge for the lecturer given the size of the class. As the size of the class increases the greater the effort from the educator. Small details such as the use of a microphone or the frequent move in class /lecture theatre can have a huge impact. "Far more than with specialist students the service course lecturer has to be a showman and salesman as well as teacher" (Pollock & Wilson, 1976).

3. *Challenge them by linking different statistical topics together.* Such linkages indirectly lead to revisions of terms, concepts and meanings. Revision is a "ticket" to learning and understanding. We strongly believe that revision is highly important, recalling the old Greek pedagogical motto: «η επανάληψη είναι η μητέρα της μάθησης», *meaning*: "repetition is the mother of learning". Speaking about repetition and having in mind what Marton & Saljo (1976) have noticed about memorization and reproduction and how that may be linked to a surface learning, we can commend that "controlled" repetition has to be handled carefully from the lecturer's side in order to achieve the optimum benefits. The lecturer must trigger the students' critical thinking by reminding them the past knowledge and challenging them to connect it to specific current problem solving cases. It is the lecturer's challenge to recall old information without repeating himself/herself.

4. *Be encouraging.* Many students have feelings of inferiority and fear when they confront with Mathematics or Statistics. These feelings severely inhibit in class participation and interaction. Therefore dealing with these students and especially in cases of mistaken answers the lecturer must treat the cases with tact and build the framework for further discussion and in class participation.

5. *Be friendly and build positive relationships with the students.* A relationship based on trust can create the base of a motivating environment for the students.

6. *Avoid systematically the "monologue-type" of lecture,* which sometimes proves to be a real challenge for the lecturer depending on the relative student responses. In this attempt, by asking questions or making jokes we tried to create a pleasant environment that could lead to constructive dialogues. However, to extend the subject further, we believe that the size of the class plays a major role into the development of constructive dialogues. The pleasant environment often found in small size classes cannot be found as easily in large size classes.

7. *Provide instant feedback.* This should be one of the fundamental goals for a lecturer to pursue. By providing instant feedback (on questions addressed in the class) we achieve to clarify hidden misconceptions and we ease the process of learning. A constructive dialogue can contribute towards that process. However, there are other various ways that a lecturer/teacher could use in

order to provide feedback. Characteristically, we can mention the written feedback provided once marking students' reports, the Personal Response System (PRS or clickers), computer based quizzes, revision classes or one-to-one visits to the office.

7.1 Feedback provided by marking students' reports: In our view this task consists another important way of engaging with the students by providing them a useful feedback (in writing) which can assist further the learning processes.

7.2 Personal Response System (PRS) Tutorials: The students seem to really enjoy the PRS Tutorials. They responded with enthusiasm to the various questions posed giving us the chance to develop constructive dialogues in two different size classes (1st group: 15 students, 2nd group: 80 students). In fact, sometimes the students face the questions posed to them (during the PRS Tutorial) more seriously than the ones posed to them during the regular lecture. The reason is that they believe that these questions are linked somehow with their final assessment and therefore they feel obliged to pay attention.

7.3 Educational Tools – rpanel package: The package provides a set of simple interactive controls for R functions which are particularly useful for creating dynamic graphics. Indeed the “statistical cartoons”, developed and incorporated into rpanel, have proved to be very useful tools in a teaching context offering the opportunity to the students to engage and actively participate in a statistical thinking process via discussion with the educator. The aim is to provide tools which make it easy for lecturers to produce drawings to explain ideas and for students to explore data and concepts (Bowman, 2008). A variety of examples are available at: www.stats.gla.ac.uk/~adrian/rpanel.

7.4 Web-based system / Multiple Choice Quizzes: In the department of Statistics (University of Glasgow), in partnership with colleagues elsewhere, we devote significant time and effort to carefully develop a web-based system for creating multiple-choice statistics quizzes. This computer-aided assessment system provides immediate tailored feedback to the learners in Statistics courses (<http://www.mathstore.ac.uk/teststat/intranet>). The feedback addresses each student's particular errors, thus fostering their statistical thinking.

It is a learner-oriented system which highly enables active student participation in the learning process. Five quizzes have been created related to the statistical issues of: *Introduction to MINITAB, Sampling Distributions and Interval Estimation, Regression and Correlation, Experimental Design and Categorical Data*. The four quizzes consist of 10 questions related to a statistical scenario (apart from the first which consists of five questions) and the students have two attempts for each question. This offers to the students the facility of gradually: engaging with the statistical problem, take a decision (according to the question of interest), obtain tailored feedback, reflect on the feedback and attempt a second time in case of a mistaken first effort.

During the academic year 2008-2009 the system was successfully used for the first time for formative assessment; it was not used for summative assessment purposes. However, the quizzes form a component of assessment in the 2009-2010 Session.

7.5 Revision Classes: The classes, which took place in the revision week or very near to the final and re-sit exams, were designed in such a way so as the students to come along and ask what needed most to be clarified.

7.6 One-to-one visits to the office after a student's request: This can be one of the best ways to focus on the individual student needs strengthening their relationship with the lecturer. It is though a time consuming process demanding a lot of “devotion” from the lecturer's part which needs to be arranged “wisely” in order to accommodate the needs of the students without affecting tremendously the existing workload for the educator.

8. *Encourage the students to want rather than have to understand the underlying mathematical principles.* It is the power of visualization, and the excitement and the interest aroused by real life examples – examples related to the students' main specialisation that contribute towards this direction.

WAYS OF ASSISTING THE EDUCATOR TO BECOME A FACILITATOR

Means to achieve student engagement

The means used to achieve the above mentioned goals had to do with:

- a. Clear statements of the course objectives and intended learning outcomes (from the beginning of the session).
- b. Lecture delivery using frequent questions in order to create effective dialogues.
- c. Successive use of instructional media such as: board and slides to... more advanced multimedia such as computer-based ones. From our personal experience, changing the pace and focus from the PowerPoint presentation to the black board can contribute significantly into retaining students' attention throughout the lecture.
- d. Constant effort to develop speaker's/listener's skills including presentation skills.
- e. Delivery of well structured content lectures.
- f. Good preparation for each lecture (lecture notes/material to be distributed to the students, personal notes). Pollock and Wilson (1976) emphasize the need of exceptional care in order to prepare the lectures given the constraint that "students selected for other disciplines will show far more variability in statistical potential than one's own specialist students".
- g. Prepare lecture notes / presentations in such style / format that potentially could cover special audience requirements (students with specific needs – e.g. dyslexia). Be ready to adjust to the needs of the students.
- h. Be flexible, creative and foremost vigilant.
- i. Ask students to express their opinion about the design of the lecture/course in regular time intervals during the teaching session.

Students' involvement in the teaching process - Questionnaires

In reference to the latter point, paper based questionnaires were designed requesting students' opinion which proved to be of fundamental importance to our academic practice as they provided a clearer understanding of our performance, indicating strengths and weaknesses. In fact, at the sessions of the second semester, one questionnaire was distributed at the end of the first week of lectures and the second one at the end of the session. The feedback received from the first questionnaire was used for the:

- effective engagement and communication with our students;
- indication to the students that their opinion is highly valuable for the design of the teaching method;
- evaluation of our practice during the session process;
- application of adjustments and alterations in our teaching process.
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The second questionnaire has provided a highly informative feedback with respect to the:

- final evaluation of my academic practice for that particular session;
- issues to be taken into consideration for the future.
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Necessary ingredients for the plan to be executed and implemented successfully, were the substantial (personal) effort and very good time management.

Following collection and analysis of students' comments and suggestions, the next day of classes the students were informed about the alterations that would follow into the teaching process. If in certain cases no alterations had to be made, these cases were justified with clear explanations. We believe that the students must be always aware of all the matters related to their learning so that open and constructive dialogues are built. *Education is about conceptual change, not just the acquisition of information* (Biggs & So-Kum, 2007).

The decision to involve the students in the "design" of the teaching method has had significant impact on their final feelings leading the majority of the respondents to express that they wouldn't have preferred another method of lecturing.

Means of assisting a lecturer/teacher in achieving good practice in teaching

- Communication with the predecessor lecturer of the course;

- Communication with the department being serviced. “Ideally, broad aims of service course should be defined by agreement between the Statistics Department and the department being serviced” (Pollock & Wilson, 1976). Let us also recall that the relevance of the content is a key issue for the higher education for a few decades now “no matter how eloquent, elegant, sophisticated, organised, structured, and affective the instructor’s teaching method is, the content should remain a key variable and never be neglected to secondary status” (Goldschmidt, 1976);
- Online resources: there is a vast number of online resources developed specifically to support lecturers in achieving good practice in learning and teaching (see for example <http://www.mathstore.ac.uk/> and <http://www.rsscse.org.uk/>);
- Peer observations – From personal experience we believe that whenever such observations are feasible they are highly beneficial for evaluating the academic practice and for considering what needs to be retained or altered in the near future;
- Constant personal development with respect to teaching and learning in higher education by joining personal development courses / workshops / seminars / conferences (In UK for example the new academic staff involved with teaching are strongly encouraged and supported by their institutions to register in postgraduate courses related to teaching and learning issues);
- The educators should always be informed from regional and international centres devoted to the support and promotion of good practice in higher education. For example in UK the Mathematics Statistics and Operational Research Network of Higher education Academy (MSOR) or the Centre of Statistical education of the Royal Statistical Society (RSSCSE) and the International Association for Statistical Education (IASE), foster the promotion, support and improvement of statistical education at all levels not only locally but also around the world.

Issues for further consideration

Bancroft (1972) referred to the dual nature of Statistics, indicating that it is not only an important science in its own right but also provides an investigative methodology for obtaining new knowledge in numerous other disciplines. Hence, according to Bancroft, this dual nature has to be taken into consideration once designing and providing undergraduate and postgraduate training programs in statistics. Pollock and Wilson (1976) marked the “lack of specific training of lecturers to deal with service teaching problems”. It is our personal belief, that this latter point is still valid for the new generations of educators. Under the current demand for excellence in various aspects of academic life, the educators often find themselves obliged to pay attention more to specialist teaching rather than to service teaching. Given that Statistics is a specialisation characterised strongly by its collaboration with other disciplines, we argue that this collaboration can be highly facilitated by the creation of positive feelings towards the profession which can arise starting from the classrooms of service courses.

CONCLUSION

Reflecting back to our teaching experience we strongly believe that it is the lecture’s/teacher’s motivating role that is highly responsible (most of the times) for the student’s in class participation and engagement.

We strongly believe that our aim should be directed towards the constant improvement and development of a motivational teaching environment that will meet the learning objectives of the diversified group of our students. We must design those teaching methods and techniques that will constitute effective learning tools for our students.

As an overall concluding remark, we can say with certainty that this novice experience has had a tremendous impact on our personal development.

We have always been eager in sharing with our students the beauty of Mathematics and Statistics. However, by delivering service courses, we had to face the reality: the students do not always share the same enthusiasm from the first instance. It is through a constant effort for engagement with the students that the change can be made! And this is something that has been

justified through this novice academic practice. However, the following phrase from one of our students:

“It makes a difference when a professor obviously cares that you understand & that you are interested” stands alone as a reward and as a strong motivator for our academic practice for the years to follow.

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