

TEACHING STATISTICS TO NON-STATISTICS MAJORS

Kolentino N. Mpeta, Diteboho Xaba, Ellen K. Materechera and Mamolahluwa A. Mokoena
North West University, South Africa
kolentino.mpeta@nwu.ac.za

It is not always easy teaching statistics to students from varied backgrounds who are pursuing a variety of careers and thus have different motivations. What makes it even more difficult is the attitude that some of the students might have towards mathematics and statistics in particular. The situation is further compounded when teaching students who previously failed the statistics course in question and hence have no hope in as far as passing statistics is concerned. One approach that has been effective in assisting the students at the North West University is the use of supplementary instructors. A sample of 310 first year students is used to show the effectiveness of the supplementary instruction. This paper seeks to highlight the challenges faced in teaching statistics to students from diverse faculties as well as approaches, including supplementary instruction, that are found to be effective in such situations.

INTRODUCTION

Many students find the transition from high school to university very difficult and are often not prepared for the academic and social challenges they encounter in tertiary education (Cronje, 2012; Price, Lumpkin, Seemann & Bell, 2012; Zeger, Clark-Unite & Smith, 2006; Beasley, 1997). Tertiary institutions are pressured to widen access and admit students who are not adequately prepared for higher education (Zerger et al, 2006) and many are first generation students. This results in increased risk of failing or dropping out. A high dropout rate of first year students is a common trend in South Africa. The Mafikeng Campus of the North-West University is not spared from these challenges. Drawing from the results of three different assessment strategies (the Technology Assisted Language Learning [TALL] test, the National Benchmarking Test [NBT] as well as a Reading Assessment Test), the indication is that many students are under-prepared at entry level for the challenges they have to face in their academic journey (Mokoena & Materechera, 2012). Furthermore, particular units of study are often problematic for many first year students because they involve learning a whole new set of skills and different disciplinary discourse patterns and conventions (Beasley, 1997). In the case of first year statistics and/or mathematics, the problem is further compounded by the negative attitude that most students have towards these two disciplines as well as the diverse students' educational backgrounds. There is therefore need for faculty to adopt teaching strategies that will be effective in assisting students to learn in such situations.

TEACHING APPROACHES

In the paragraphs that follow we will briefly discuss collaborative teaching before focussing on the supplemental instruction approach, using North West University, Mafikeng Campus as a case study.

Collaborative Teaching

One effective approach when dealing with students from a diverse background and pursuing diverse qualifications is collaborative or team-teaching. Team teaching can be defined as a group of two or more teachers working together to plan, conduct and evaluate the learning activities for the same group of learners (Goetz, 2000). Davis (1997) lists the following advantages of team teaching:

- It responds to the diversity of student learning styles and strategies by diversifying teaching styles and expertise.
- It changes focus of the class from a teacher-centred one, in which the single teacher is the sole authority to a more dynamic one.
- Team teaching allows students to gain a wider base of content knowledge than would be possible from the instruction of one instructor alone.

- Team teaching encourages students and teachers to view the material from multiple perspectives.

Team teaching can have a highly positive impact on student learning outcomes, largely due to the increased opportunity for student participation that team teaching provides. The presence of more than one instructor in the classroom increases the occasions for student-teacher interaction (Wadkins, Miller, and Wozniak, 2006). More importantly, a collaborative teaching environment invites students to take a more active role in the learning process. Because team teaching encourages a variety of perspectives on a topic, students are more likely to feel they can make valuable contributions to class discussions (Anderson and Speck, 1998).

Supplemental Instruction

Supplemental instruction (SI) is an academic support program that is geared at increasing student performance and retention. It targets large classes, at-risk modules (courses) which are traditionally difficult and are characterised by high failure and high withdrawal rates. SI provides regular scheduled small, out-of-class peer collaborative facilitated sessions that do not require any particular teaching method, but instead emphasizes the use of cooperative learning. Etter, Burmeister and Elder (2000) suggest that Supplemental Instruction (SI) as a cooperative learning model is designed to improve student performance and retention in courses with a history of high failure and withdrawal rates.

At the Mafikeng campus, departmental program managers identify at-risk-modules and communicate with the Academic Development Centre (ADC), a centre that offers academic support to students. A module chosen for SI support is challenging for the majority of enrolled students, so all students in the module are invited to participate in SI sessions on a voluntary basis. Since SI is open to all students in the targeted module, pre-screening of the students is unnecessary. Students of varying abilities participate and no effort is made to segregate students based on academic ability. The lecturers select high performing senior students who would have gone through the particular module and these are recommended to ADC to become the SI leaders/facilitators for the particular module. The SI facilitators in the SI program are trained extensively and are expected to facilitate learning rather than lecture or spoon-feed the tutees (Hurley, Jacobs & Gilbert, 2006; Malm, Brynfors & Mörner, 2010). The SI leaders keep records of the sessions including registers from which this paper draws the participants. The North West University, Mafikeng campus fully established an SI programme in 2009. The expected benefits that motivated the institution to establish SI are:

- SI reduces attrition while it raises the general level of students' performance.
- The lecture room experience is enhanced, not duplicated.
- Evaluation is based on actual student performance rather than student perception of the services.
- SI is proactive and participatory rather than reactive and passive.
- Students achieve higher marks while they learn effective study skills.
- SI provides peer collaborative learning experiences, which promote assimilation into the campus culture, a method strongly upheld by the National Qualifications Framework (NQF) of South Africa.
- SI enjoys a non-remedial image while offering academic support to all students enrolled in historically difficult modules.
- SI makes efficient use of study time.
- SI provides an opportunity for students to develop friendships among students and staff, an important factor in retention.

Techniques Employed During SI Sessions

The think-pair-share, turn to a partner and group discussion techniques are mainly employed during the SI sessions. In the think-pair-share strategy, students work in pairs to come up with solutions to given statistical problems. This technique encourages participation of all students

attending the SI session. The turn to a partner technique encourages students to attempt solving a statistical problem individually and if they cannot they then turn to the nearest person (partner) and get assistance. Group discussions allow students in groups of between three and five members to share ideas. Each group member is encouraged to actively participate in the group discussions.

METHOD

Hypothesis testing was used to determine whether attending supplemental instruction sessions made a significant difference in the students' performance. A sample of 310 drawn from a population of 464 first year students was used in the experiment. One hundred and eighty (58%) of the students did not attend supplemental instruction sessions while 130 (42%) attended. Both participation marks (continuous assessment marks) and final exam marks were used for the analysis.

A one-sided t-test was used with the hypothesis stated as follows:

$H_0: \mu_A = \mu_{DA}$ (There is no difference in the students' performance)

$H_1: \mu_A > \mu_{DA}$ (Students who attend supplemental instruction sessions perform better than those who do not attend)

The test was performed at a significance level of $\alpha=0.05$.

RESULTS

The results were as shown in the tables below:

Table 1: Participation Marks

Group	n	Mean	Std Deviation	p-value
Attending	130	63.8	17.2	$P < 0.01$
Non-attending	180	58.1	18.7	

Since the p-value < 0.05 , we reject the null hypothesis and conclude that students who attend supplemental instruction sessions perform better in the continuous assessment than those who do not attend.

Table 2: Exam Marks

Group	n	Mean	Std Deviation	p-value
Attending	130	63.3	19.6	$P < 0.0001$
Non-attending	180	54.3	20.4	

Since the p-value < 0.05 , we reject the null hypothesis and conclude that students who attend supplemental instruction sessions perform better in the exam than those who do not attend.

DISCUSSION

The higher average grades of students that attend SI sessions confirm that they benefitted academically and thus reflect the effectiveness of this approach in teaching students with diverse educational backgrounds who are pursuing a variety of careers and having different motivations. The effectiveness of SI can be attributed to the fact that it essentially adopts "a student centred, collaborative, learning strategy ... to transform students from being passive, 'teacher' - dependent, uncritical recipients and reproducers of information into engaged, questioning, reflective and autonomous learners" (Gardiner, 1996).

The think-pair-share, turn to a partner and group discussion collaborative techniques that are employed in the SI sessions encourage students to work to find the answers among themselves instead of having the answers recited to them by a tutor every time. This helps the students break their dependency on tutoring and helps them progress toward becoming independent learners. Different students bring different strengths and weaknesses to the SI sessions. One student may

have a good understanding of probability distributions, for example,, in which case, they can help the other students who are struggling with the concepts involved; while, that same student may struggle with another topic, say, confidence intervals or hypothesis testing and require assistance from one of the other students who has a better understanding of the concepts thus the students can help each other to overcome their weak areas. Students' understanding of material is reinforced when they explain it to other students.

One of the key features of SI is peer-assisted learning in which undergraduate students serve as discussion leaders and help their peers grasp difficult course concepts. Students begin to expand their thinking and approaches to learning when they see their peers as a suitable source of knowledge (Evans, Forney, & Guido-DiBrito, 1998). Further, interactions with peers in academic setting are known to have important implications for student retention (Tinto, 1997).

Further research could focus on examining the relationship between student performance and frequency of attending SI sessions as well as finding out whether there are differences in attendance of SI between genders.

REFERENCES

- Anderson, R. S., & Speck B. W. (1998). Oh what a difference a team makes: Why team teaching makes a difference? *Teaching and Teacher Education*, 14(7), 671-86.
- Beasley, C. (1997). Students as teachers: The benefits of peer tutoring. In R. Pospisil and L. Willcoxson (Eds.), *Learning through teaching* (pp. 21–30). Proceedings of the 6th Annual Teaching Learning Forum, Murdoch University, February 1997. Perth: Murdoch University.
- Cronje, A. (2012). The value of peer collaborative tutoring: A South African case study. *Conference of the International Journal of Arts & Sciences*, 5(2), 27-33.
- Davis, J. R. (1997). *Interdisciplinary courses and team teaching*. Phoenix: American Council on Education/Oryx Press Series on Higher Education.
- Etter, E. R., Burmeister, S. L., & Elder, R. J. (2000). Improving student performance and retention via supplemental instruction, *Journal of Accounting Education*, 18, 355–368.
- Evans, N. J., Forney, D. S., & Guido-DiBrito, F. (1998). *Student development in college: Theory, research, and practice*. San Francisco: Jossey-Bass.
- Gardiner, R. (1996). *Supplemental instruction (SI)*. Brisbane, Australia: Academic Staff Development Unit, Queensland University of Technology.
- Goetz, K. (2000). Perspectives on team teaching. *EGallery*, 1(4). www.ucalgary.ca/~egallery
- Hurley, H., Jacobs, G., & Gilbert, M. (2006). The basic SI model. *New Directions for Teaching and Learning*, 106, 11–22.
- Malm, J., Brynfors, L., & Mörner, L. (2010). Supplemental Instruction (SI) at the Faculty of Engineering (LTH), Lund University, Sweden. An evaluation of the SI-program at five LTH engineering programs autumn 2008. *Australasian Journal of Peer Learning*, 3(1), 38–50.
- Mokoena, M., & Materechera, E. (2012). Underprepared students: How best can they be creatively supported? *International Journal of Arts & Sciences*, 5(5), 23-31.
- Price, J., Lumpkin, A. G., Seemann, E. A., & Bell, D. C. (2012). Evaluating the impact of supplemental instruction on short- and long-term retention of course content. *Journal of College Reading and Learning*, 42(2).
- Tinto, V. (1997). Classrooms as communities: Exploring the educational character of student persistence. *Journal of Higher Education*, 68(6), 599-623.
- Wadkins, T., Miller, R. L., & Wozniak, W. (2006). Team teaching: Student satisfaction and performance. *Teaching of Psychology*, 22(2), 118-120.
- Zerger, S., Clark-Unite, C., & Smith, L. (2006). How supplemental instruction benefits faculty, administration, and institutions. *New Directions for Teaching and Learning*, 106, 63–72.