

Improving Statistical Education through the Experience of Reflective Practice

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Abstract

This thesis is the recount of a study that began with the aim of unpacking the statistical expertise of the teacher and author, with the intent of improving statistics teaching and learning. In the process of doing this, the researcher examined the expertise of other experts through a case study of a statistics professor, concept mapping of ideas of statistics professionals and through an examination of statistical literature. As the researcher and teacher moved to a position of accepting that *statistics is a study of variation*, she discovered a failure by authors of many introductory textbooks to appropriately acknowledge variation as a (the?) fundamental statistical concept.

In the second phase of the research, the teacher constructed a pre-tertiary statistics curriculum and taught it to a cohort of 64 students. Drawing upon constructivist ideas, teaching was based on using activities to elicit statistical thinking in students. Exercises on measurement, sampling, probability, and questions about relationships were all used to illustrate the nature of variation. Within-session student assessment involved providing a written reflection upon the statistical ideas generated in class. The ideas needed to be exemplified in an everyday context. End of session examinations included a concept mapping exercise to explore students' understanding of major statistics concepts. The continued process of unpacking expertise and reflective practice led to the teacher modifying the curriculum for the second implementation. The theme adopted was *statistics is the study of variation as it occurs throughout the research process* (ethics, questions asked, design, measurement, sampling, description, analysis and drawing conclusions). For this cohort of 79 students, their understanding of statistical concepts improved, but their satisfaction with the subject declined. For the third implementation, the subject was again modified to include an explicit focus on *learning how to learn statistics*. In this third variation of the subject, the 61 students continued to have a good understanding of the statistical concepts but higher levels satisfaction with the subject.

During the various implementations, the teacher-researcher experienced shifts in interpretation of the educational literature. Students demonstrated in their reflective homeworks that the act of reflection was not automatic. Students' reflective homeworks often focussed on hard concepts or easy concepts, but not necessarily on the range of concepts. They often focussed on the particular or the general patterns but not both. When transferring to a new task, many retained a chronological ordering rather than a logical ordering of material. Some students perceived only one level of meaning, while others perceived multiple levels. Rather than perceiving a need to have students construct their knowledge (through activities), the emphasis shifted to selecting pedagogical techniques that would reveal what knowledge the students had constructed and how they experienced the learning environment. Students were now perceived as constructing knowledge no matter what pedagogical approach was used. The activity basis for teaching was retained, with the emphasis on the benefit of experiencing statistical thought through the completion of a task.

An explicit focus on learning how to learn was incorporated into the third implementation as students needed to be aware of the gains they had made in learning to learn. They needed to learn how to deal with negative emotions. Important and complicated ideas, easily acquired using the activity based approach, were often dismissed as too easy to be important, and the associated feeling was that they had not learned anything. Students needed to be able to handle the discomfort associated with uncertainty; uncertainty expressing ideas in writing; uncertainty associated with not being told what to learn; and uncertainty in not obtaining deterministic answers. Students needed to learn to write effectively. They needed to value the learning process and to recognise what they had overcome in the process of learning statistics, whether it was overcoming issues arising inside or from outside the classroom.

Based on the experience gained in this project, a model for improving statistical education in the broadest sense would involve a reflective practitioner methodology. Reflection upon student lives (current, past and future intent); curriculum (fundamental statistical ideas), the pedagogy, and how students experienced learning are all objects for reflection. Reflection also includes the comparison and contrast of experiences and understanding of the teacher with those reported in the literature. In this study, the key to improving students' understanding has been attributed to that part of the reflective process that has focussed on making explicit the fundamental concepts of the discipline. Improving students' affect has been attributed to the inclusion, within the activity-based pedagogy, of an explicit focus on learning how to learn.