

Abstract

Statistical literacy is regarded as essential for good citizenship, employment, and practical day-to-day living. The ubiquitous nature of data and computers in contemporary society has increased both the need for statistical literacy and the means of developing statistical literacy.

This study investigated students' acceptance of Fathom[®] virtual simulation and re-sampling as a legitimate mathematics tool, the teaching and learning of the explicit determination of sample size when sampling from large populations, and students' development of use of Fathom statistics education software.

The study was conducted as a three-week long classroom unit of work taught in two Year 9 classes and a detailed study of twelve students in Tasmania, Australia. Pedagogical best practice principles derived from statistics education research guided the study. These included engagement with the big ideas of statistics, active learning and data sets students can understand and value, statistical enquiry that cultivates statistical habits of mind, the use of technology tools that allows students to explore data and concepts, mathematical experiences of substance, provision of a developmental pathway for students to study statistics at more senior years, and authentic assessment.

Fathom was developed for senior high school and tertiary study, and its use in Australian high schools is relatively novel. Students' unfamiliarity with the software presented at least two challenges: developing acceptance of Fathom's virtual re-sampling probability simulator as a legitimate mathematical tool and acquiring basic fluency in the software's use such that the software was not a constraint on learning. Students' acceptance of the probability simulator was cultivated purposefully through a process of formal statistical enquiry where students examined the fairness of the Fathom virtual die. Students' development of use of Fathom re-sampling was examined from the three aspects of key terminology, graphical data representations, and their relationship with Fathom. The principles of instrumental genesis guided the introduction to, and the examination of, students' use of Fathom.

Sample size is presently ignored in the high school curriculum, and students may complete formal school education with unsophisticated notions of sample size, possibly first acquired in upper primary school. The sample size model $e = \pm 1/\sqrt{n}$, which relates the sample size n , to the margin of error e , of the accuracy of measurement, was used in this study. A foremost consideration was that the model was potentially accessible and that students could apply their understanding in a real-life context. Large populations were studied because

formal mathematical treatment is relatively simple. Students' work samples were assessed using the SOLO taxonomy, and situated abstraction was used to observe students' development of understanding of selected mathematical concepts.

The study concluded that a process of statistical enquiry may be used both to promote acceptance of virtual simulation and to foster the development of statistical "habits of mind." The sample size model $e = \pm 1/\sqrt{n}$ has application in Year 9 principally to mathematise traditional Law of Large Numbers activities, where the computing power of virtual simulation allows exploration of very large sample sizes. The introduction of re-sampling and the sample size model in Year 9 provides the foundation for the consideration of contextual tasks in more senior school years. The study suggests that Fathom is suitable for Year 9 students, but recommends further research in the use of re-sampling to exploit fully the software's potential.