

USING MEDIA REPORTS TO DEVELOP STATISTICAL LITERACY IN YEAR 10 STUDENTS

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Statistical literacy should be a key goal in preparing students to understand statistical information which is often reported in the media. This research is centred on the teaching of a specially designed unit of work on statistical literacy to ninety Year 10 (14-year-old) high school students that emphasised media reports both in the teaching approach and in the pre- and post-assessments. The students' test responses were analysed using the SOLO taxonomy framework for assessment and results were compared to those in previous studies. The issues that arose in the development of the teaching unit, the preliminary results on changes in levels of statistical literacy observed, and the factors that could affect the development of statistical literacy, such as mathematical and English ability, are briefly reported. The students' and teachers' reactions to the unit of instruction using media reports are also discussed.

INTRODUCTION

Today there is widespread recognition, by statisticians, mathematicians, scientists and teachers, of the need for developing statistical literacy so that the public can cope with the barrage of statistical information assailing them. Media reports are a key method of conveying statistics to the general public and they can also be used as a means of promoting statistical literacy at the school level. Today's high school students will need to develop their statistical literacy if they are to make reasoned judgements and form balanced opinions in the future. The New Zealand school mathematics curriculum already encourages the development of statistical thinking. Usually focusing on the carrying out of statistical investigations it is not common practice to study media reports. The term statistical literacy has often been used in recent literature (Watson, Collis and Moritz, 1994; Watson, 1997; Gal, 2000; Watson and Callingham, 2003). Most researchers agree that statistical literacy encompasses the skills, attitudes, and knowledge that enable a person to function in the information age. Much of the evidence of the need for statistical literacy is anecdotal rather than emerging from research. Very little specific research has been conducted on how the level of statistical literacy can be raised. Although evaluating media reports is acknowledged in the New Zealand mathematics curriculum, it has never been assessed or specifically taught. Education is seen as a key way of achieving statistical literacy and research is needed not only to determine the skills, concepts, attitudes, and dispositions necessary to attain high levels of statistical literacy but also to investigate and develop possible teaching approaches.

DEFINING STATISTICAL LITERACY

Gal (2000) defines statistical literacy as the ability to interpret and critically evaluate statistical information and the ability to discuss or communicate reactions to it along with that person's opinions or concerns. Wallman (1993, p. 5) suggests this ability is particularly needed to respond to the information that permeates everyday life and believes that it involves an appreciation of "the contributions that statistical thinking can make in public and private, professional and personal decisions." Watson (1997) recognizes the importance of the need for a basic understanding of statistical language and concepts alongside a questioning attitude and ability to apply these concepts in critiquing information. Current thinking supports the view that statistical literacy should be grounded in a media context since it is in this format that the public must operate. Gal (2000) proposes a model of statistical literacy incorporating five interrelated knowledge bases with supporting dispositional elements. These include literacy skills, such as comprehending written text, understanding statistical terms that are used in media reports and making sense of tables, charts, and graphs. Knowledge also includes an understanding of statistics and mathematics and an awareness of general world knowledge that provides context. The ability to think critically and reflect on claims made is also regarded as essential. The dispositional

element involves people's beliefs and attitudes, a propensity to ask questions, to recognize that there may be alternative interpretations and to develop a critical stance.

For the purposes of this research statistical literacy is defined in the way that Gal (2000) suggests – incorporating the skills, knowledge, attitudes, dispositions and the ability to think critically, discuss, and make judgements. Statistical literacy overlaps into the wider areas of statistics and mathematics knowledge bases with their inherent thinking skills. General literacy for reading and comprehending text, tables, charts, and graphs also plays its part. Statistical literacy can be envisaged as a Venn diagram (Figure 1).

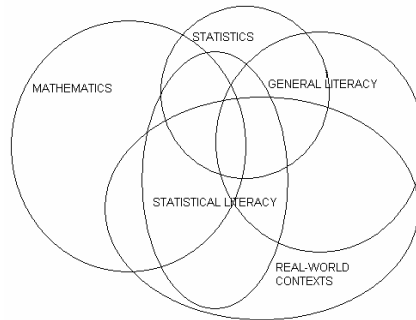


Figure 1: Statistical Literacy Model

In addition, this research encompasses Watson *et al.*'s (1994) earlier work which emphasized the importance of grounding statistical literacy in the context of media reports. The standpoint adopted proposes that real life context, so apparent in media reports, is essential for the development of statistical literacy.

TEACHING STATISTICAL LITERACY USING MEDIA REPORTS

Current research states that a study of statistical literacy should be relevant to students' lives, engage students by using appropriate context and provide them with motivation (Watson *et al.*, 1994; Gal, 2000; Hayden, 2004). The key points of motivation, relevance, and context can all be considered in the light of using media reports. Promoting statistical literacy using media reports could provide students with motivating examples. Since students are very likely to encounter statistical reports in newspapers, teachers should be preparing them to read, understand and weigh up those statistics. Watson *et al.* (1994) feel that newspaper articles or other media items can be adapted for use in the classroom and believe they would be particularly useful if they related to students' interests. As long as the topics are understandable to students, current media items may assist statistical literacy formation. One way to determine what issues arise in everyday life is to have students look at the news which can be "a better guide to real life than looking at the table of contents of a textbook" (Hayden, 2004, p. 1). Media reports are readily available but care must be taken in choosing examples that are suitable and effective guidelines must be developed on how best to use them in a classroom. Watson (1997) feels that these reports encourage students to find out the usefulness of having statistical literacy skills. The media context provides interesting, relevant, real-world situations and because students will see how they can apply their statistical knowledge to understanding the world, they may be more motivated to engage with the topic. Media reports can also be used to assess statistical literacy especially if they reflect the teaching approach adopted.

Statistical literacy is acknowledged in the New Zealand mathematics curriculum but it has never been assessed. Anecdotal evidence suggests that it has not even been taught. There are no curricular or resource materials available and there is no tradition or history of teaching it. No research appears to have been conducted on teaching using media reports at high school and whether this can make a difference to the level of students' statistical literacy. Little information exists on how best to meet the statistical literacy needs of high school students although it has also been argued that teachers must "work *directly* towards statistical literacy" (Gal, 2000, p. 147). This research focussed on a teaching intervention that emphasised media reports. Thus it

was necessary for the researcher to design a course and gather resource materials of topical media reports that had particular relevance to students.

METHOD

The research involved 12 hours of teaching of a specially designed unit of work. It was taught by three teachers to approximately ninety Year 10 average ability high school students at a large New Zealand multicultural, average socio-economic, co-educational school. The emphasis of the unit was on media reports both in the teaching approach and in the pre- and post-assessments. At the introduction of the statistical literacy unit, a 20 minute *pre-test* was given to the students. At the conclusion of the unit the students sat a 50 minute *post-test* that included some questions from the pre-test. Both tests featured short-answer questions involving media reports on statistical literacy concepts. A convenience sample of 44 students agreed to their results being used in the research. The changes in levels of statistical literacy observed, and the students' English and mathematical ability, obtained from Year 9 end-of-year examinations, were analysed. How the students and teachers reacted to a unit of instruction using media reports was also investigated using questionnaires. Pre- and post-tests were analysed using Biggs and Collis (1982) SOLO Taxonomy to determine what changes in statistical literacy occurred as a result of the teaching intervention. The SOLO Taxonomy model is a framework that is primarily concerned with "classifying outcomes, not students" (Biggs and Collis, 1982, p. 20) that gains evidence of the quality of students' answers. SOLO reveals how *well* they have learnt rather than how *much* they have learnt. Past research by Watson *et al.* (1994) used the SOLO Taxonomy in their research into statistical literacy using a media survey as a means of assessment.

PRELIMINARY RESULTS AND DISCUSSION

The pre- and post-test results were quantified by allocating higher values to responses at higher levels of the SOLO taxonomy and the scores were then compared. There is extremely strong evidence ($p < 0.001$) of a statistically significant improvement in students' statistical literacy after instruction (Figure 2). From *t*-tests it is estimated that the 95% mean difference confidence interval between students' pre-test scores and post-test scores is between 7 and 15 percent. The average statistical literacy level of the students prior to instruction was at a multi-structural SOLO level which agrees with Watson *et al.*'s (1994) findings. The students were still at a multi-structural level after instruction but had improved their position within that level. Possible factors that may contribute to students acquiring statistical literacy such as mathematical and English ability were investigated. There was no correlation between mathematical ability and students' performance in the post-test. However, there was a positive linear correlation between English ability and statistical literacy (Figure 3).

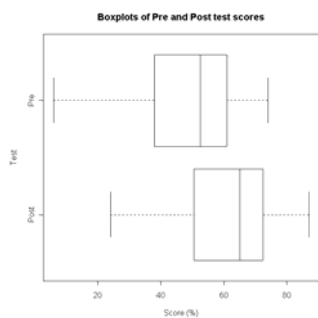


Figure 2: Pre- and Post-test comparison

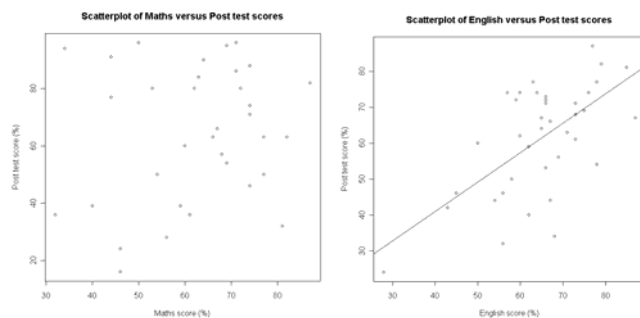


Figure 3: Post-test association with Maths and English Year 9 end-of-year examinations

These findings support the claims of Gal (2000) that students need to have reading and listening literacy skills if they are to achieve statistical literacy. Pryor (2001), researching undergraduate students' statistical literacy, found that without English literacy, knowledge, skills, critical and statistical thinking cannot even be employed. Watson and Callingham's research (2003) found that the underlying mathematical and statistical knowledge bases are important but their

integration needs to occur in the context of socially-based media examples. Thus mathematical ability alone is insufficient to achieve statistical literacy.

Questionnaires revealed that students had become more aware of the statistics found in media reports. When asked what main ideas they had gained from the unit, students commented on how they had learnt: to judge things they read; to be aware of how graphs can mislead; the importance of statistics in the world; about sampling and randomness; to put what they had learnt into practice and “to look deeper” into statistics. Some students’ comments on the unit were: “really interesting”; “it is a good life skill and it should be taught to everybody”; “fun!”; and “I learnt that you can’t trust everything that you read.” They acknowledged that reading media reports was at times difficult and that more effort in terms of ‘thinking’ was required.

Participating teachers preferred the teaching unit to a traditional approach because: it gave more opportunity in the classroom for discussion; it had practical real-life applicability; it was a more ‘natural’ way of covering traditional elements; “a huge improvement on skills-based teaching”; students engaged more with the topic; students felt that they had ideas to express; it was “the most interesting topic I’ve taught”; and “it gave my students skills to cope with the statistics they meet up with.” Teachers said they personally “learnt a lot” and commented on the need for professional development to manage classroom discussions and develop conceptual understanding in their students. All agreed that students had to use higher level thinking and that careful choosing of media reports to accommodate reading stamina and a lower reading age is essential. A broad learning objective to open students’ minds to question the statistics they read and to promote discussion and thinking was felt to be the focus of the unit.

Students becoming aware of misleading graphs, judging what they read, and not trusting everything they read illustrate their developing dispositions of questioning, critiquing, and reflecting on claims viewed by Gal (2000) and Watson (1997) as essential for statistical literacy. Teachers’ comments on their students discussing what they read, expressing personal responses, and developing open minds further support this development. Hayden (2004) and Watson (1997) believe that statistical literacy should be useful and practical and students’ comments on seeing the importance of statistics and putting their new knowledge and acquired dispositions into practice show an appreciation of this. A media report context for teaching knowledge and skills was acknowledged as more engaging, motivating, and practical (Wallman, 1993; Watson *et al.*, 1994; Watson, 1997; Gal, 2000). Teachers agreed that the teaching of a whole raft of integrated knowledge, skills, and dispositions must be specifically addressed (Gal, 2000).

When students are supported in their discussions in the classroom and encouraged to be open, with a healthy dose of scepticism, along with a persistence of effort, then they will begin to make inroads into interpreting statistical information. The goal and challenge is to prepare students to be educated, aware, and thinking, statistically-literate citizens. Using media reports in the classroom is one way of promoting these goals.

REFERENCES

- Biggs, J. and Collis, K. (1982). *Evaluating the Quality of Learning: The SOLO Taxonomy*. New York: Academic Press.
- Gal, I. (2000). Statistical literacy: Conceptual and instructional issues. In D. Coben, J. O’Donoghue, and G. Fitzsimons (Eds.), *Perspectives on Adults Learning Mathematics* (pp. 135-150). Dordrecht, The Netherlands: Kluwer Academic.
- Hayden, R. (2004). Planning a statistical literacy program at the college level: Musings and a bibliography, <http://www.statlit.org/pdf/2004/HaydenASA.pdf>.
- Pryor, H. (2001). *Assessment of the Statistical Literacy Ability of some Tertiary Students using Media Reports*. Unpublished M.Sc. Thesis, The University of Auckland, New Zealand.
- Wallman, K. K. (1993). Enhancing statistical literacy: Enriching our society. *Journal of the American Statistical Association*, 88(421), 1-8.
- Watson, J. (1997). Assessing statistical thinking using the media. In I. Gal and J. Garfield (Eds.), *The Assessment Challenge in Statistics Education*, (pp. 107-122). Amsterdam: IOS Press and the International Statistical Institute.
- Watson, J. and Callingham, R. (2003). Statistical literacy: A complex hierarchical construct. *Statistics Education Research Journal*, 2(2), 3-46.

Watson, J., Collis, K., and Moritz, J. (1994). *Authentic Assessment in Statistics using the Media*. Report prepared for the National Center for Research in Mathematical Sciences Education – Models of Authentic Assessment Working Group (University of Wisconsin). Hobart, Australia: University of Tasmania, School of Education.