DEVELOPMENTAL CHANGES IN AUSTRALIAN SCHOOL STUDENTS' INTEREST FOR STATISTICAL LITERACY

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Research in the mathematics context demonstrates that in general students' interest declines during their secondary school education. Such research has not, however, explored student interest for specific aspects of their learning. This study reports on apparent age differences in student responses to items in a statistical literacy interest inventory. A sample of 791 Australian secondary school students responded on a five-point Likert scale to 31 self-descriptions relating to their interest for statistical literacy. The analysis of cross-tabulations of school year with level of interest revealed that younger students are more likely to be interested in activities related to chance and the use of computers. Older students, on the other hand, are more likely to value the ability to interpret statistics in media and scientific contexts. Interview data is used to illuminate these findings and implications for the teaching of statistics are discussed.

John Dewey (1910, p. 91) described interest as "the annihilation of the distance between the person and the materials and results of his action." Not surprisingly, students who report an interest in the subject matter that they learn are known to produce qualitatively superior learning outcomes (Schiefele, 1991). As reported in Carmichael, Callingham, Watson, and Hay (2009), there is a dearth of research concerning students' interest in a middle school statistics context. In a mathematics education context, however, interest is known to predict participation rates in post-compulsory mathematics courses (McPhan, Morony, Pegg, Cooksey, & Lynch, 2008). Yet such interest typically declines as students progress through their formal education (Krapp, 2002), with more pronounced declines occurring near the onset of adolescence (Watt, 2008). Although such findings are of concern, they are typically based on questionnaires that use quite general items, for example "how interesting do you find maths?" Ma and Kishor (1997, p. 37) criticized such items as only providing "crude approximations to 'true' attitudes" and recommended the development of instruments that assess student attitudes to the specific areas and activities that are typically encountered within mathematics. This study reports on student responses to one such instrument: an instrument designed to assess student interest towards statistical literacy.

THE STATISTICAL LITERACY INTEREST MEASURE (SLIM)

Statistical literacy is defined as an ability to interpret and critically evaluate messages that contain statistical elements (Gal, 2003). In an Australian context, the underlying statistical concepts for such literacy are introduced in the chance and data strand of the compulsory mathematics syllabus. Most children should have met these concepts by the time they have completed their eleventh year of school education at an age of approximately 16 years.

It is hypothesized that students' interest in statistical literacy will have two components, their interest in the subject matter related to statistical literacy and their interest in the activities and contexts that they encounter in the learning of related statistical concepts. In addition to this, it is hypothesized that such interest will have three dimensions. The first is related to the value that students place on the various interest objects associated with statistical literacy, namely the activities, contexts and concepts that they encounter. The second is related to the positive affect they may have experienced during their interaction with these interest objects. The last is related to students' epistemic curiosity towards these objects, as it is acknowledged that younger students with developing statistical literacy may lack the knowledge related to some statistical literacy interest objects.

Based on the above components and dimensions for student interest in statistical literacy, a theoretical model, detailed in Carmichael (2008), was developed. From this model 20 self-descriptions were written and tested. A sample of these items is shown in Table 1, which also highlights the dimensions, topics and contexts that each item is thought to assess. In addition to these items, 11 general interest self-descriptions were also included in the instrument. These assess

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some of the behavioral consequences of interest, for example a predisposition to re-engage in the material and a tendency to experience states of extreme involvement akin to that of “flow” (Csikszentmihalyi, 2002). Each item was placed with a 5 point Likert scale that ranged from 1 (*not me at all*) to 5 (*describes me well*).

Table 1. Sample of items from the Statistical Literacy Interest Measure (SLIM)

Dimension	Topic	Context	Item
Positive affect	Beginning inference	Classroom	I’m interested in conducting surveys of other students at my school.
Epistemic curiosity	Graphs	Sports	I would like to know how a graph could be used to compare my sports team with other teams.
Value	Averages	Media	It’s important to me personally that I can understand news reports that use averages.

METHODOLOGY

The 31 items comprising SLIM were tested on a convenience sample selected from 16 Australian secondary schools. The schools which these students attended were targeted so that the resulting sample as close as possible reflected the Australian secondary school population. Consequently a mix of government, independent, single-sex, co-educational, rural and metropolitan schools from four Australian states were invited to participate. A total of 1384 students were then invited to participate in the study, 791 returned complete surveys, a response rate of 57%. The ages of students ranged from 11.2 to 16.8 years, with a mean of 13.6 years. Forty six percent of respondents were male. Students’ year level at school ranged from year 6 through to year 10.

Of interest to this study are differences in the way students of different ages responded to the items in SLIM. In order to detect such differences, 31 two-way tables were constructed that compared student responses to each of the items with their year level at school. More specifically, and due to the typically small number of responses to high interest categories, the five category Likert scale was collapsed into three categories. Categories 4 and 5 into one category of high interest, categories 2 and 3 into one of moderate interest, and category 1 retained as a low interest category. In addition, and in order to achieve relatively equal group sizes, students in years 6 and 7 were assigned to the lowest year level group ($n = 266$), year 8 students assigned to the next year level group ($n = 267$), and year 9 and 10 students to the highest year level group ($n = 258$). Thus each two-way table compared three categories of interest–high, medium, and low–with three categories of age–Years 6 and 7, Year 8, and Years 9 and 10. A Pearson chi-square test of association was conducted for each two-way table to detect significant associations between age and interest.

Eight participating students were also interviewed concerning their responses to the questionnaire. Some of this data, where relevant, is also reported.

RESULTS

Of the 31 comparisons, age-interest associations for just seven items in SLIM were significant (at the 1% level) and these are shown in Table 2. Students in Years 6 and 7 tended to be more interested in the content of items SLI11, SLI12b, GI31 and GI36. For example, 25% of year 6 and 7 students expressed high interest in working out probabilities (item SLI11), while only 12.4% of year 9 and 10 students expressed the same level of interest. Similarly, 38% of year 6 and 7 students expressed high interest in using computers (item SLI12b) while only 22% of year 9 and 10 students expressed the same level of interest.

Students in Years 9 and 10 tended to be more interested in the content of items that reflected a valuing of statistics. They expressed higher levels of interest in the content of items SLI26, SLI28 and SLI29. For example, 51% of year 9 and 10 students expressed high interest in being able to believe scientific claims based on data (item SLI26). Only 29% of year 6 and 7 students expressed the same level of interest.

Table 2. Items with significant age-interest associations

Item ID	Group with most interest	Item
SLI11	Years 6 & 7	I'm interested in working out the probabilities (or chances) for dice, coins and spinners.
SLI12b	Years 6 & 7	I'm interested in using computer programs to help me investigate problems involving data.
SLI26	Years 9 & 10	It's important to me personally that I can believe scientific claims that are based on data.
SLI28	Years 9 & 10	It's important to me personally that I can understand graphs that appear on the internet or in newspapers.
SLI29	Years 9 & 10	It's important to me personally that I can arrange data into tables.
GI31	Years 6 & 7	I get so involved when I work with data that I sometimes lose all sense of time.
GI36	Years 6 & 7	I like to work on statistics problems in my spare time.

DISCUSSION

Younger students appeared to be more interested in simple chance-related experiments. This is likely due to the inherent uncertainty associated with such experiments, for as one year 7 student remarked, "…with probability there is a different answer every time you do it, and I find that really, really, interesting, because with something like times tables you get the same answer each time." In addition to an interest in chance events, younger students were also more likely to be interested in a computer related context. As observed by Mitchell (1993), computers in a secondary mathematics context can provide novelty.

As described in item GI31, younger students were more likely to experience a deep involvement when working with data than older students, although overall this item was the second most difficult item in terms of eliciting high responses from students. One year 7 student, who responded with a 4 to this item on the original 5 point scale, remarked "…if something is interesting and I'm really into it, I can just sit there all day." It is of concern that older students are less likely to acknowledge the experience of flow in their learning. This may reflect a dense mathematics curriculum where there is insufficient time for students to lose themselves in investigations. As Watson (2008, p. 31) argued, there needs to be time in the curriculum for students to "experience the excitement of meaningful applications of mathematics and statistics". Perhaps there is extra time available for younger students, which may reflect their relatively strong endorsement of item GI36, which was overall the most difficult item for students to endorse.

In general, the older students tended to endorse more readily items with the common stem 'It's important to me personally". Their stronger endorsement of items SLI26 and SLI28 may reflect the valuing of statistically literacy that comes with maturity. Their stronger endorsement for item SLI29, however, appears to be more related to one of valuing the mastery of simple tasks. Arguably the term "important" in the common stem of these items, may reflect extrinsic motivation, perhaps the importance placed on success by parents, rather than the intrinsic motivation that is associated with interest.

CONCLUSION

As reported in this paper there appear to be age differences in the types of activities that students find interesting. Younger students are likely to be interested in activities that involve probability and/or the use of computers. In addition to this they are more likely to experience deep involvement or flow when working on their statistics related problems and be more predisposed to re-engage in statistical activities. Older students, on the other hand, are more likely to see the value in statistical literacy. Given the reported decline in students' interest during adolescence (Watt, 2008), and the theoretical justification for this (Krapp, 2002), this later finding suggests that the valuing associated with importance does not reflect the valuing associated with interest. While older students are more likely to see the importance of statistical literacy, they are less likely to want to re-engage with the domain than younger students. The latter appear to have a stronger emotional attachment: they like learning about chance and data.

Psychological theories of interest development predict that novelty and uncertainty will contribute to interest (Silvia, 2001). The results of this study provide a reminder to statistics teachers that the inherent uncertainty associated with chance events can engage students' interest. Unfortunately the novelty associated with tossing coins and die appears to wane, and with it students' interest. Given the relatively high levels of reported interest in computers, even by older students, it is recommended that both chance and technology play a more prominent role in the teaching of statistics. Some statistical software packages, such as *TinkerPlots* (Konold & Miller, 2005), have built in simulation tools that enable students to construct survey data using probabilistic notions. Such an approach provides an alternative method for teaching data analysis, one that elicits students' interest from sources related to novelty and uncertainty. This alleviates the problem of finding a sufficient variety of data contexts to match the individual interests of students in the class.

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