Astronomy and Science Student Attitudes

A Review and Validation of a New Instrument

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1. Introduction

Content knowledge has very much dominated astronomy education research, though research into student affect, identity and attitude is a not too distant second (Slater et al., 2016). However, much quantitative research into this latter area has been undertaken with non-validated instruments. The majority of papers that apply *validated* instruments used Zeilik's Attitude towards Astronomy Instrument (1997). However, no known study was found whereby a significant change was reported using this instrument.

Much of the current research also focuses on university students, however many countries are presented with a problem in student attitudes towards science in middle and high school which has prompted various intervention schemes.

In response to these gaps within the current research, the goal here was to offer an **attitude survey that is science and astronomy specific** and is appropriate for **middle school, high school and college level student** audiences. It was crucial that the survey was also **sensitive to change** in order to appraise the effectiveness of various approaches and interventions in shifting student attitudes.

2. Methods

The new **Astronomy and Science Student Attitudes (ASSA)** instrument is an adaptation of previously validated instruments that presents a more specific astronomical focus. Instruments include those from Kind et al. (2007), a previous study by Fitzgerald et al., (2016) that utilised work from Goodrum et al., (2001) and **11 newly created items** intended to probe student interest specifically in astronomy.

The new instrument was undertaken by 319 high school students during 2016 as part of their participation in the Australian-based project, **Our Solar Siblings.**

3a. Results

Factor and Reliability Analysis

Exploratory factor analyses were computed using SPSS with a principal components extraction and direct oblimin rotation. Examination of the Eigen plot led to the inspection of various solutions whereby a constrained 6-factor analysis solution produced the most promising results.

In an endeavour to identify reliable scales while seeking a parsimonious solution, reliability analyses were computed for 6 items (where possible) within each potential scale. A 7th factor was also computed as a division from the Interest in Astronomy scale which also had an additional 6 items of loadings that were considered to describe student interest in Science Outside of School.

Various item combinations were trialled and the final result for each factor is displayed in Table 1. Following this**, Oneway-ANOVA and Student-Newman-Keuls post hoc tests** were computed, and results revealed all factors to hold a **high construct validity**.

Factor	Description	Number of Items	Cronbach's Alpha	Tukey's Test of Additivity
1	Interest in Astronomy	6	.862	.997
2	Practical Work in Science	6	.910	.992
3	Teacher's Actions	6	.900	1.128
4	Ability in Science	6	.898	.776
5	Benefits of Science	3	.810	.861
6	Personal Relevance	5	.833	1.374
7	Science Outside of School	6	.848	1.226

Table 1: The Seven Factors in the ASSA

3b. Results

Score Distribution

Figure 1 shows the percentage of respondents that rated items within each of the 7 factors between 1 (Strongly Disagree) and 5 (Strongly Agree). Skewness and kurtosis of each factor was then measured in order to assess the **normality distribution** more thoroughly.

The 7 factors showed a slightly negative skew (higher scores were more common). Strongest factors were Science Outside of School (mean =3.23, SD =.860), Ability in Science (mean =3.39, SD =.877), Interest in Astronomy (mean =3.51, SD =.845), Practical Work in Science (mean= 3.62, SD =.764) and Practical Work in Science (mean =3.81, SD =.864). These factors all possess skewness values within a range of ±1 and are therefore not limited by floor or ceiling effects. Each factor has room for respondents to move upwards and downwards on the scales.

Skewness was most apparent in the Benefits of Science (mean score =4.16, SD =.773) and Teacher's Actions (mean score =3.77, SD =.843) scales, where values were outside ± 1. However, the participants did not represent a random sample and were typically from high ability classes with good teachers that commonly engage with astronomy.

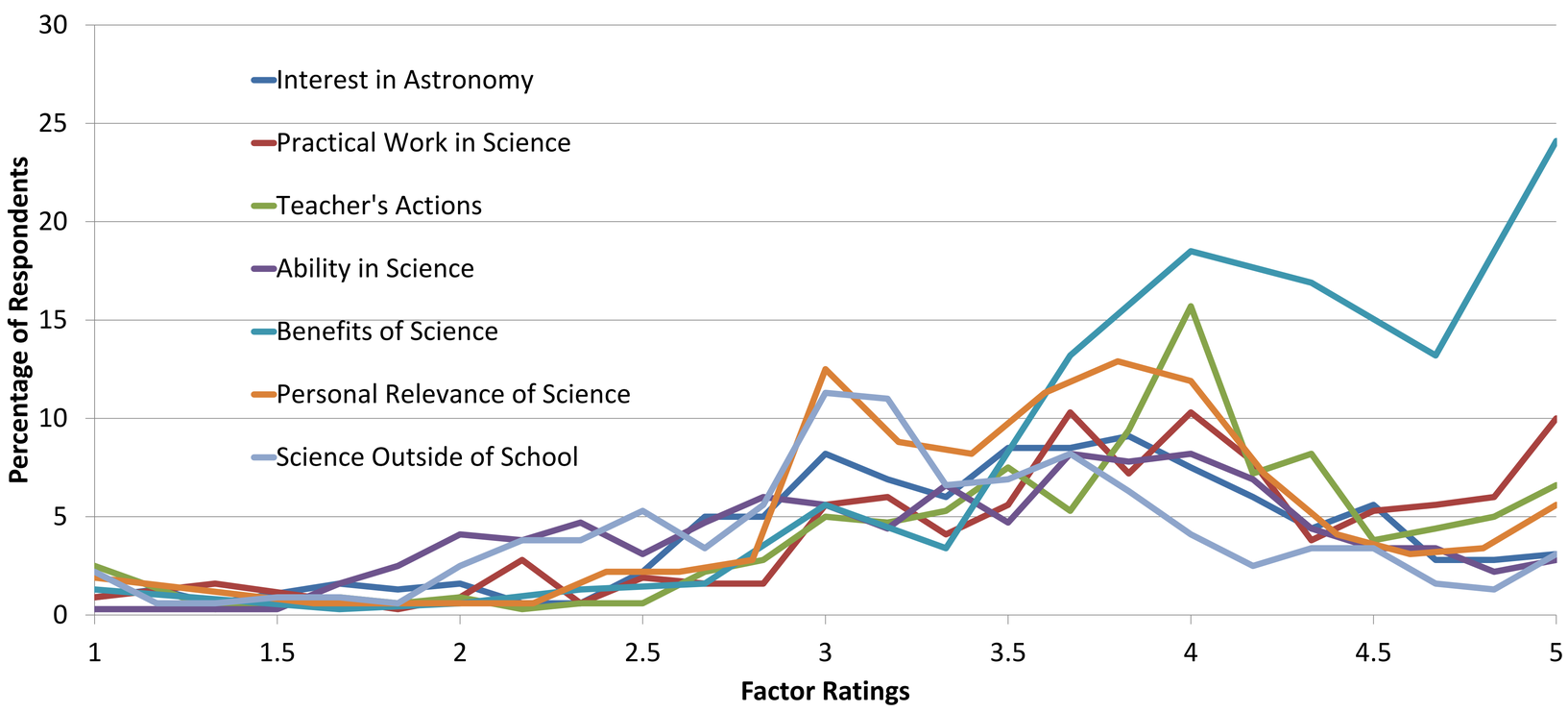

Figure 1: The Distribution of Participant Scores for Each Factor

4. Conclusion

Although 2 of the 7 factors appeared problematic in their normality distribution, they still possessed a skewness value within ±2. Under circumstances where a random sample is selected, we can be confident that the ASSA will present a **robust scale** for measuring students' attitudes, is not limited by floor or ceiling effects and is sensitive to change.

Even now, these results indicate that the ASSA provides a stronger set of scales than Zeilik's scale and we are therefore heading in the right direction. The ASSA also offers an instrument that is suitable for use in high school classrooms and not restricted to undergraduate students. The next phase of this research will involve **random sampling** of participants so that results are not constrained by selection effects.

5. References and Contact

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