

# RESEARCH SUMMARY

## *Science literacy in the International Baccalaureate Primary Years Programme (PYP): NAP-SL outcomes*



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### **Background**

This research study, by Deakin University, evaluated the science literacy of a sample of students undertaking the International Baccalaureate (IB) Primary Years Programme (PYP) in schools across Australia. This was accomplished by administering the 2012 National Sample Assessment in Science Literacy (NAP-SL) to children in 10 schools, representing a mix of state, urban, regional, government and non-government schools. PYP student tests were analysed and compared with the NAP-SL 2012 results and Australian Proficiency Standards. Comparisons were also made between male and female PYP students, and PYP students from government or non-government schools. State comparisons were made when possible.

Deakin University investigated the following key research questions.

1. How do PYP students perform on the Australian NAP-SL?
2. How do the results achieved by PYP students and schools compare with national and state results?

### **Research design**

The NAP-SL is one of several testing regimes developed by the Australian Curriculum, Assessment and Reporting Authority (ACARA); it is conducted triennially with a randomly selected national sample of students. According to ACARA, the science items and instruments of the NAP-SL “assess outcomes that contribute to scientific literacy, such as conceptual understandings, rather than focusing solely on facts. They also assess student competence in carrying out investigations in realistic situations” (ACARA 2010: 3). Proficiency standards developed by ACARA, in consultation with education experts, highlight what science skills children should be able to demonstrate at different levels. For year 6 children, the target group for the NAP-SL test, the anticipated proficiency level is 3.2, although the NAP-SL test covers five proficiency levels: level 2, level 3.1, level 3.2, level

3.3 and level 4. Proficiency level 3.2 is defined as a challenging level of performance where students have demonstrated more than the minimal skills expected of year 6 students (ACARA 2010).

Researchers from Deakin University administered the 2012 NAP-SL test with Australian PYP schools to gauge PYP student performance in scientific literacy and to compare PYP and national NAP-SL results. Comparisons between male and female PYP students, government and non-government IB schools, and urban and regional IB schools were also attempted. Ten schools were chosen from IB schools that have delivered the PYP for at least three years. Sites were apportioned nationally to represent populations of students and, whenever possible, included both non-government and government schools. A final sample of eight non-government and two government sites was used. Seven of these schools were in urban settings and three were in regional areas. Two classes from the same grade level were selected from each school, which allowed for a student cohort of between 40 and 50 children at each site. It was assumed that approximately 50% of the students at each site would be male, and 50% female. Unfortunately, in the final breakdown of numbers, the researchers did not achieve an adequate proportion of females (26%) when compared with the number of males (74%).

The 2012 NAP-SL test completed by students consisted of two components: “Objective test” and “Practical task”. The test booklets administered with the participating PYP schools were printed versions of the ACARA NAP-SL materials, with one small variation. On the front page of the document, coding was used for the state, school, year and student. All identifiers were removed. A student’s age was requested in years and months to ensure an accurate comparison with the ACARA test results.

To examine the question of how PYP students perform on the NAP-SL in comparison with the 2012 national NAP-SL sample, raw scores from the students’ test results were converted to scaled scores. All students were then assessed

against the five proficiency levels—2, 3.1, 3.2, 3.3 and 4—to determine how they performed.

To investigate how the results of PYP students and schools compared with national and state results, the researchers undertook a number of defined comparisons, including studying the national and state mean scores and comparing these to the PYP NAP-SL results. In addition, they completed a comparison of the distribution of students across the proficiency levels for all three groups (national, state and PYP). Lastly, comparisons between male and female PYP student results were made and viewed against national scores and proficiency levels.

## Findings

### Research question 1: How do PYP students perform on the Australia NAP-SL?

All IB students' NAP-SL tests were marked and the results were contrasted in a number of ways. Initially, for each test item, all the IB student results were compared with the national results for that test item. For each of the 49 questions in the NAP-SL test, except for one, PYP students outperformed the national average. In general, PYP students also performed better on the advanced-level questions (that is, proficiency level 4). Results for level 4 questions are shown in Table 1.

Item number	Proficiency level	Number of students correct (n = 337, P – n = 310)	PYP % correct	National % correct
Q24	≥ 4	28	8.3	3.7
Q36	≥ 4	67	19.9	14.3
Q37	≥ 4	40	11.9	8.9
P6	≥ 4	67	21.6	5.4
P10	≥ 4	74	23.9	3.5

**Table 1: IB students' performance on advanced-level questions**

As noted above, for year 6 children, the target proficiency standard for science literacy is 3.2. On the objective test component of the NAP-SL, 77.8% of PYP students performed at or above this standard, and 22.2% were below the 3.2 benchmark. For the national sample, the result was 51% above and 49% below. Table 2, which combines both the objective test and practical task results, shows that 83.3% of students undertaking the PYP were at or above the suggested year 6 proficiency level of 3.2.

This compares favourably with the national sample, in which 51.4% of children were at or above the 3.2 level and 48.6% were below.

Objective test and practical task results combined			
Distribution of year 6 student performance			
Percentage of national sample (2012) in proficiency level	Proficiency level	PYP student results	%
0.3%	Level 4 and above	3	1.0%
9.0%	Level 3.3	70	22.6%
42.1%	Level 3.2	185	59.7%
39.6%	Level 3.1	22	7.1%
9.0%	Level 2 and below	8	2.6%

**Table 2: A comparison of the profile of proficiency for PYP compared with schools nationally for the objective test and practical task combined**

A further notable result in Table 2 is that 23.6% of PYP students performed at proficiency level 3.3 or above, compared with 9.3% for the national sample. According to ACARA, year 6 students who “exceed the proficient standard (of 3.2) demonstrate exemplary performance” (ACARA, 2010:48).

Table 3 identifies that PYP students also performed higher than national results when proficiency levels for males and females were compared. Nationally, approximately 51% of female students performed at or above a proficiency level of 3.2; however, the figure was 79% for female PYP students. Meanwhile, 80% of male PYP students performed at or above a proficiency level of 3.2, whereas 52% of males nationally achieved or exceeded a proficiency level of 3.2. Much higher proportions of both male (25.1%) and female (16%) PYP students performed at proficiency level 3.3 or above, when compared with national male (9.8%) and female (8.8%) NAP-SL results.

Percentage of national sample (2012) at proficiency level		Proficiency level	Percentage of PYP students at proficiency level	
Male	Female		Male	Female
0.4	0.2	Level 4 and above	1.3	0
9.4	8.6	Level 3.3	23.8	16
41.9	42.30	Level 3.2	55.3	63
38.4	41.00	Level 3.1	17	18
9.9	8	Level 2 and below	2.6	3

Table 3: Gender distribution of national and PYP students' proficiency levels

### Research question 2: How do the results achieved by PYP students and schools compare with national and state results?

This question was addressed by undertaking a number of defined comparisons.

#### Government and non-government IB World School comparisons

Students from government PYP schools performed better than non-government PYP students (Mean 0.58, SD 0.96; Mean 0.37, SD 0.84, respectively); however, both groups retain a very large standard deviation, indicating wide variation in attainment in different schools. This can be interpreted as a medium effect size ( $d = 0.24$ ), with students in sample government schools performing moderately better.

#### Urban and rural/regional IB World School comparisons

Turning to differences between urban and regional PYP students, the researchers found that urban students and regional students (Mean 0.60, SD 0.80; Mean 0.40, SD 0.88, respectively) differ marginally. A Cohen's effect size for these two groups of students ( $d = 0.25$ ) suggests that children from urban schools are achieving moderately better results when compared with students from rural/regional schools.

#### PYP girls and boys comparisons

Within the PYP sample, both genders were represented but unfortunately featured far fewer girls ( $N = 88$ ) than boys ( $N = 245$ ). Table 4 shows the mean scores and standard deviations of both groups.

Assessment	Gender	Mean	Standard deviation	N
Cognitive	Males	22.8	6.37	245
	Females	21.9	6.04	88
Practical	Males	6.3	2.15	245
	Females	5.1	2.71	88
Both	Males	29.1	7.67	245
	Females	27	7.53	88

Table 4: Male and female proficiency scores

As can be seen in Table 4, differences in the means for both male and female PYP students for cognitive and practical NAP-SL test items were merely one score point, and the standard deviations for the two groups are similarly very close. Effect sizes were calculated for cognitive assessment items ( $d = 0.143$ ), practical assessment items ( $d = 0.518$ ) and the combined NAP-SL assessment ( $d = 0.274$ ). The relatively small number of girls makes strong inferences unwarranted, but there appears to be some support for drawing the conclusion that the practical task of the NAP-SL was less well done by the girls as a group. This finding, however, would need to be investigated with larger sample sizes to make reliable comparisons between boys and girls.

Gender results for male and female PYP students were also compared with national mean scores. Table 5 identifies that both boys and girls at PYP schools achieved notably higher scores, with PYP girls achieving a mean score 56 points greater than the national female sample and PYP boys surpassing the national male mean score by 68 points.

	Results for male year 6 students		Results for female year 6 students	
	Raw score/51	Scaled score	Raw score/51	Scaled score
National results	23	394	23	395
PYP results	29	462	28	451

Table 5: Comparison of male and female raw and scaled scores

#### State comparisons with national data

Issues associated with the number of schools in the study, and the number of tests returned from participating schools, limit the conclusions that can be made at a state level. Nonetheless, the data confirm the overall results reported earlier: that students undertaking the PYP performed better than students involved in the national study.

Looking at the state results (Table 6), it can be observed that PYP students, at state level, achieved higher mean scores than national results by state. It should also be noted, however, that the between-school variance is high, even when considering two schools in one state.

State	IB School	Number of test results	PYP mean score	Category	National re-sults/ state
Victoria	A	21	460.75	U/NG	393 (Range 237–544)
	H	48	476.75	U/G	
South Australia	K	41	460.82	U/NG	392 (Range 234–542)
	F	3	Insufficient data	R/NG	
	J	10	388.9**	R/NG	
	B	20	586.75	U/G	
Western Australia	C	56	494.30	U/NG	406
Queensland	D	21	459.62	R/NG	392 (Range 236–544)
Australian Capital Territory	E	43	494.83	U/NG	429 (Range 269–580)
New South Wales	G	74	455.96	U/NG	395 (Range 231–560)

\*\* denotes that the practical test results not included in the PYP mean score.

**Table 6: State comparisons with national data**

## Summary

Key results emerging from the analysis indicate:

- PYP students performed well in the NAP-SL test when compared with national NAP-SL results
- the scientific literacy of most students in the PYP meets or exceeds national proficiency standards

- male and female PYP students achieved higher mean NAP-SL scores and higher scientific literacy levels than national male and female results
- students from government IB World Schools generally outperformed students from non-government IB World Schools
- urban students generally performed better than students from regional schools
- the small data set for girls' results meant it was not possible to make reliable comparisons between PYP boys and girls and further investigation using larger data sets is required
- comparisons to state-level NAP-SL results suggest that PYP schools in all states gained higher test results overall.

Taken together, the results of the research suggest that PYP school students are achieving well in terms of science literacy when compared with the national results.

## References

ACARA. 2010. *National Assessment Program – Science Literacy Year 6 Report 2009*. Sydney, New South Wales. Australian Curriculum, Assessment and Reporting Authority.

This summary was developed by the IB Research Department. A copy of the full report is available at <http://www.ibo.org/research>. For more information on this study or other IB research, please email [research@ibo.org](mailto:research@ibo.org).

To cite the full report, please use the following:

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