

Ai GROUP SUBMISSION

**A Decadel Plan for the
Mathematical Sciences**

**A Submission to the Australian Academy of
Science**

FEBRUARY 2015

Ai
GROUP

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About Australian Industry Group

The Australian Industry Group (Ai Group) is a peak industry association in Australia which along with its affiliates represents the interests of more than 60,000 businesses in an expanding range of sectors including: manufacturing; engineering; construction; automotive; food; transport; information technology; telecommunications; call centres; labour hire; printing; defence; mining equipment and supplies; airlines; and other industries. The businesses which we represent employ more than one million people. Ai Group members operate small, medium and large businesses across a range of industries. Ai Group is closely affiliated with more than 50 other employer groups in Australia alone and directly manages a number of those organisations.

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Summary of Recommendations

National Foundation Skills Strategy

1. The Australian Government, as a matter of urgency, commence consultations with industry to implement priority three, *strengthening foundation skills in the workplace*, of the National Foundation Skills Strategy,

National Public Awareness Campaign

2. A national public awareness campaign about the importance of increased levels of language, literacy and numeracy skills be implemented and in consultation with industry, include a targeted workforce strategy.

LLN Workforce

3. Given the increasing skill shortages of the LLN practitioners and the anticipated increase in demand for their services, the Australian Government maintain and expand the LLN Practitioner Scholarships Program to build their capacity and support other initiatives designed to strengthen the capacity and capability of the LLN workforce.

VET Workforce

4. Further research is required to establish the numeracy capability of the VET workforce and consider measures about to increase this capability.

The level of numeracy in the Australian Workforce

5. Further research is required to develop measures to raise the numeracy levels of the Australian workforce.

The Importance of Mathematics and Numeracy to the Australian Economy

Australian workplaces are dynamic and constantly changing. The workforce needs to respond to increasing skills requirements brought about by new technologies, new work processes and increased compliance and quality assurance measures. Progressively higher levels of language, literacy and numeracy are required to support this. Modeling undertaken by the Australian Workforce and Productivity Agency indicates an increased industry demand for higher level skills. Research from the UK suggests that globalisation and the introduction of technology have rapidly grown the numeracy demands of the workforce and more workers are engaged in maths-related tasks of increasing sophistication.¹

The importance of Science, Technology, Engineering and Mathematics (STEM disciplines) for the future economic and social well-being of Australia cannot be underestimated. The Office of the Chief Scientist has estimated that 65 per cent of economic growth per capita from 1964 to 2005 is due to improvements in the use of capital, labour and technological innovation made possible in large part by STEM.² The Australian Bureau of Statistics (ABS) released a report *Perspectives on education and training: Australians with qualifications in science, technology, engineering and mathematics (STEM), 2010-11* demonstrating that STEM skills jobs such as scientists, ICT professionals and engineers, grew about 1.5 times the rate of other jobs in recent years.

*"The number of people in jobs commonly held by workers with science, technology, engineering and mathematics (STEM) qualifications grew by 14 per cent between 2006 and 2011. This compares with only nine per cent growth for other jobs. Many people have caught on with the trend, with around 2.1 million workers in Australia having STEM qualifications in 2010-11."*³

This represents about 18 per cent of the Australian workforce and the occupations that showed the highest growth between 2006 and 2011 were design, engineering, science and transport professionals (23 per cent) and ICT professionals (19 per cent). Of those employees with university level STEM qualifications, 75 per cent were employed in higher skill jobs such as Professionals or Managers. However, those with vocational level STEM qualifications fared differently, with 41 per cent working as Technicians and trades workers and 25 per cent working as Managers or Professionals.

It will be extremely difficult to meet these increasing demands for higher order skills with 4.2 million, or 40% of the workforce currently below the minimum language, literacy and numeracy (LLN) standard needed to function in a knowledge economy. Building LLN skills is critical to increasing labour force participation and increasing productivity in a higher skilled economy.

¹ <http://eprints.ioe.ac.uk/1565/1/Hoyles2002MathematicalSkills.pdf>

² *Science, Technology, Engineering and Mathematics: Australia's Future*, Office of the Chief Scientist, September 2014, page 7.

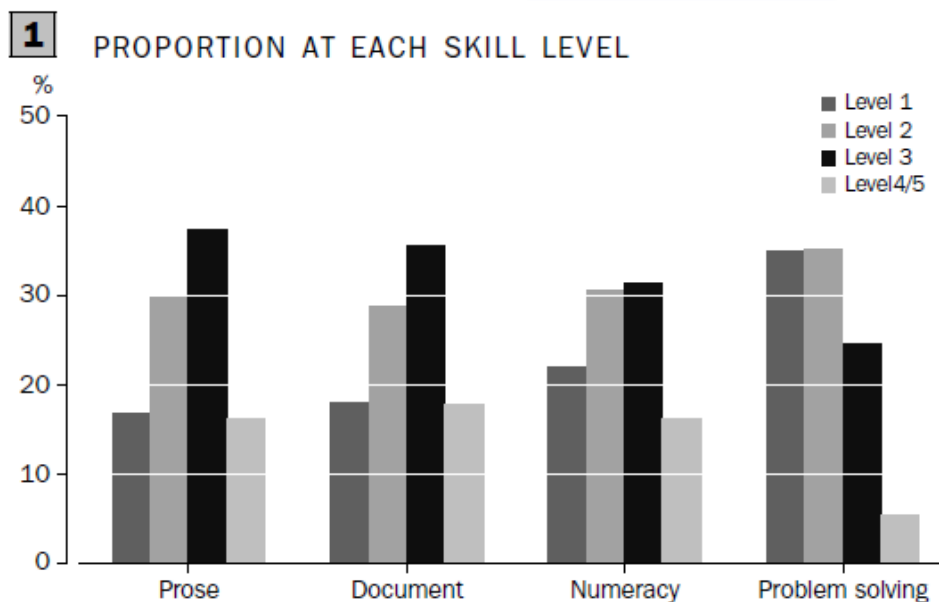
³ Media Release, *Qualifications paying off in science, technology, engineering and maths*, Australian Bureau of Statistics, 24 February 2014.

Current Literacy and Numeracy Landscape in Australia

In 2006 the Australian Bureau of Statistics (ABS) conducted the Adult Literacy and Life Skills survey. Just over half (54%) of Australians aged 15 to 74 years have been assessed as having the literacy skills needed to meet the complex demands of everyday life and work. Results were similar for document literacy (53%) and numeracy, with 47% achieving this level. Major attention was devoted to this issue in the wake of the survey which found that many Australians were below level 3, generally accepted as the “minimum required for individuals to meet the complex demands of everyday life and work in the emerging knowledge-based economy.”⁴

Capability was measured in the areas of Prose Literacy, Document Literacy, Numeracy and Problem Solving shown in Chart 1.

Chart 1: Proportion at each Skill Level (ALLS Survey)



These results translate as follows:

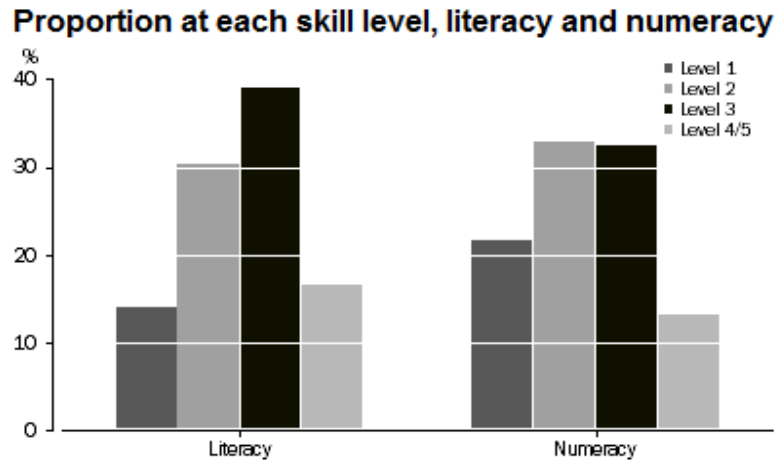
- 46% of those aged 15 – 74 years had prose literacy scores below level 3
- 47% of those aged 15 – 74 years had document literacy scores below level 3
- 53% of those aged 15 – 74 years had numeracy scores below level 3; and
- 70% of those aged 15 – 74 years had problem solving scores below level 3.

This data indicates a significant issue concerning the level of numeracy in the general population. This data was updated in 2012 with the final report of the Programme for the International Assessment of Adult Competencies (PIAAC)⁵ published later in 2013. The overall results of the preliminary findings are provided in Chart 2.

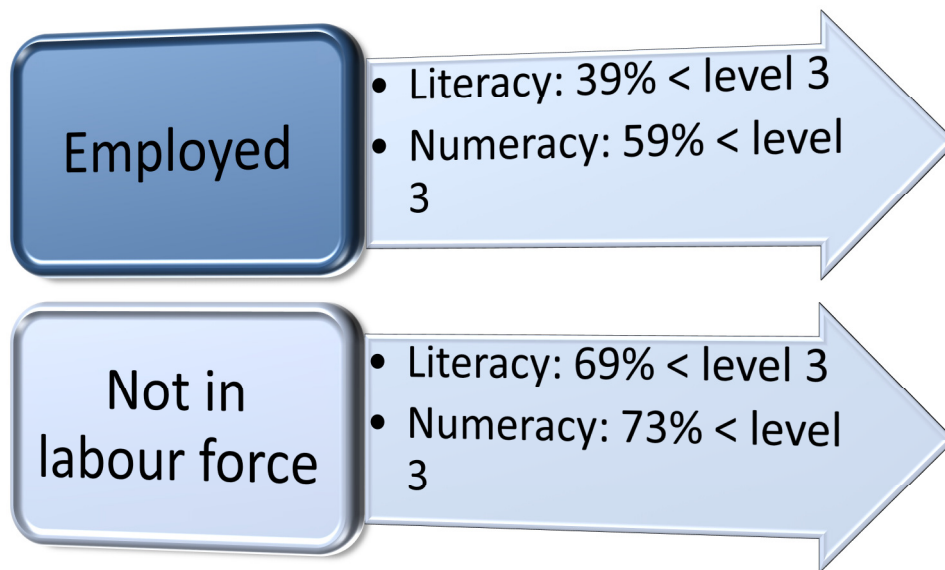
⁴ 4228.0, *Adult Literacy and Life Skills Survey, Summary Results, 2006 (Reissue)*, Australian Bureau of Statistics.

⁵ 4228.0, *Programme for the International Assessment of Adult Competencies*, Australia, 2011-2012, Australian Bureau of Statistics.

Chart 2: Proportion at Each Skills Level (PIAAC)



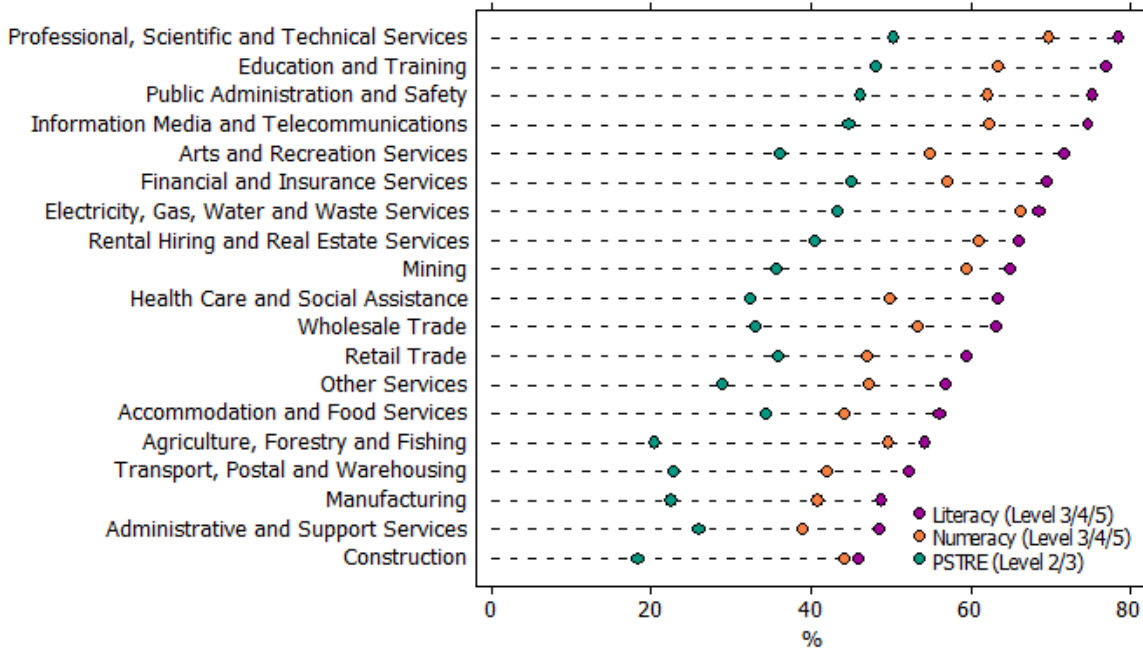
The overall results indicate that 44% of Australians aged 15 – 74 had literacy skills below level 3 and that 55% had numeracy skills below level 3. This represents a further deterioration in numeracy. It is clear that a major problem still exists. Of particular concern is that the figure is even higher at 59 per cent for the workforce.



The situation is a particular concern for many categories of occupations as demonstrated in Chart 3.⁶

⁶ 4228.0, *Programme for the International Assessment of Adult Competencies*, Australia, 2011-2012, Australian Bureau of Statistics.

Chart 3: PIAAC Literacy and Numeracy Levels 3/4/5 by Industry



This data reveals that many industries have low representation at levels 3 – 5. For example, construction, administrative and support services, manufacturing and transport, postal and warehousing all hover around 40 per cent. Or, to express this in the alternative way, about 60 per cent of those employed in these industries are operating below the agreed minimum requirement.

An analysis can also be made of categories of occupations as illustrated in Chart 4. This reveals that labourers and machinery operators and drivers have less than 40 per cent at levels 3 – 5, while for technicians and trade workers the figure is about half. This is a particular concern as this category of occupations is crucial to the future growth of the economy and includes apprentices and STEM-qualified employees.

Chart 4: PIAAC Literacy and Numeracy Levels 3/4/5 by Occupation



As well as these issues in the workforce there are concerns about the pipeline to the workforce. There are particular concerns in regard to school student performance in mathematics. The 2011 Trends in Mathematics and Science Study (TIMSS) indicates that Australia's performance in mathematics and science has stagnated over the past 16 years.⁷ Within this international research 17 countries recorded significantly higher results than Australia in mathematics for Year 4 students including most of the Asian countries, England and the United States. Of particular concern is the result that 30 per cent of Australian Year 4 students were achieving at the low international benchmark or not achieving at least at this level.⁸

The latest PISA results also present a bleak picture. The mathematics skills of 15 year olds have slipped back and 16 countries achieved significantly higher results than Australia. Australia's mean mathematical literacy performance declined significantly between PISA 2003 and PISA 2012 by the equivalent of more than a half year of schooling.⁹ The results indicate that 42 per cent of the students failed to reach the national baseline proficiency level in mathematical literacy.¹⁰ In relation to scientific literacy Australia's mean score changed little in absolute and relative terms between 2006 and 2012.¹¹

The impact of this decline is compounded by the lack of qualified teachers.¹² This was also reported in the TIMSS study where more than 20 per cent of Year 8 students were being taught mathematics by teachers who were only 'somewhat' confident about teaching the subject.¹³ A 2011 study by the Australian Council for Educational Research found that for years 7 – 10 mathematics teaching, only 62 per cent of teachers had two or more years of tertiary mathematics (the minimum requirement). More than a third were teaching out of field and 23 per cent had no tertiary mathematics at all.¹⁴ This is related to the low ATAR scores required for entry into teaching.

In the earlier ACOLA report student participation in STEM-related study in the Vocational Education and Training sector was measured.¹⁵ Results indicate that 195,000 effective full time VET students were enrolled in STEM disciplines which represent 29.9 per cent of all VET EFT enrolments.¹⁶ Over half of these were in the engineering and related technologies area (16.9 per cent), whereas agriculture, environmental and related studies (4.8 per cent), information technology (2.7 per cent) and natural and physical sciences (0.7 per cent) have much lower levels of participation.¹⁷

In ACIL Allen Consulting's 2014 review of engineering trade apprenticeships for the Australian Workforce and Productivity Agency, stakeholders, including business and training organisations, reported a fall in the

⁷ Sue Thompson et al., *Highlights from TIMSS and PIRLS 2011 from Australia's perspective*, Australian Council for Educational Research, 2012.

⁸ Sue Thompson et al., *Highlights from TIMSS and PIRLS 2011 from Australia's perspective*, Australian Council for Educational Research, 2012.

⁹ MEDIA RELEASE, 3rd December 2013, *Latest PISA results 'cause for concern', says ACER*.

¹⁰ ACER FACT SHEET, *Selected results from PISA 2012*, 3 December 2013

¹¹ As reported in *Benchmarking Australian Science, Technology, Engineering and Mathematics*, Office of the Chief Scientist, November 2014, page 93.

¹² <http://www.theaustralian.com.au/news/nation/mathematics-students-in-serious-decline>, March 10, 2010.

¹³ MEDIA RELEASE, 13th December 2012, *ACER releases results from latest international studies of student achievement*.

¹⁴ As reported in *STEM: Country Comparisons*, Final Report, Australian Council of Learned Academies, May 2013, page 17.

¹⁵ *STEM: Country Comparisons*, Final Report, Australian Council of Learned Academies, May 2013, pages 42 – 45.

¹⁶ *STEM: Country Comparisons*, Final Report, Australian Council of Learned Academies, May 2013, page 44.

¹⁷ *STEM: Country Comparisons*, Final Report, Australian Council of Learned Academies, May 2013, pages 44 – 45.

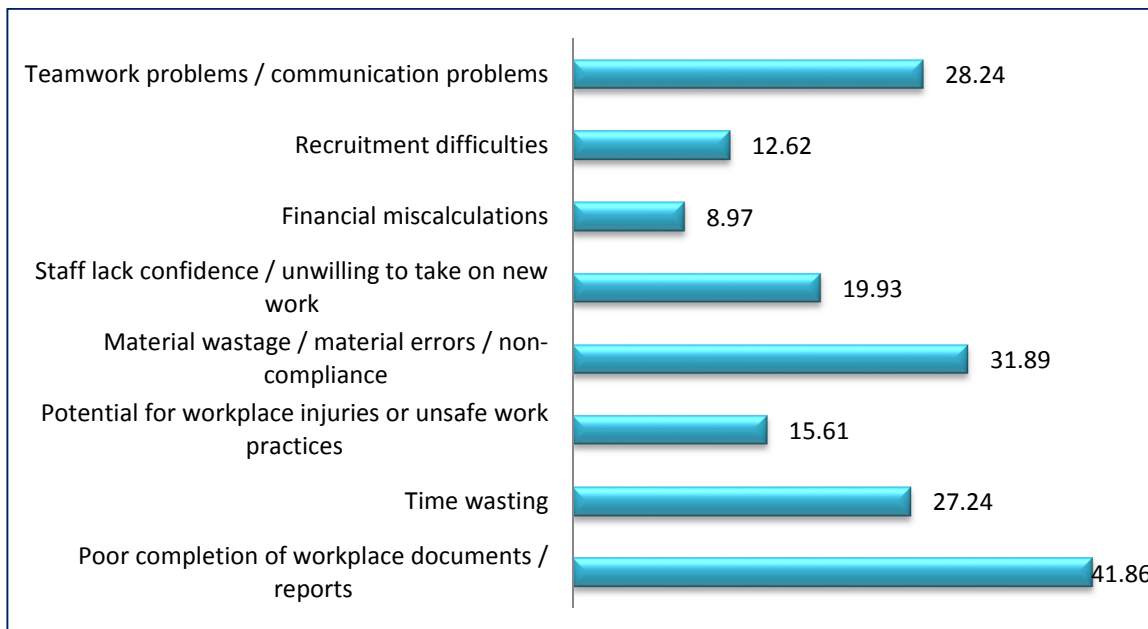
general aptitude of incoming apprentices across literacy and numeracy over recent years.¹⁸ It was noted that the engineering trades require a greater level of numeracy than some other apprenticeships, and participants consulted in the review identified this as an area of competency that a significant number of apprentices lack. Some employers indicated that contextualisation of LLN skills can be an issue in the workplace, for example knowing how to measure. The report identified an increased use of LLN testing among some of the employers, RTOs and group training organisations when screening apprentice applicants. It also found greater LLN support was incorporated during off the job training.

Whilst the report demonstrates how apprentices can be assisted throughout their apprenticeship with additional support, it points to the role of schools in preparing potential apprentices with the requisite numeracy and literacy for careers in the engineering trades. It suggests an examination of strategies to increase potential apprentice aptitude and skills in the school system which is critical to improving the productivity of apprentices. This is clearly an area where more data is required.

What employers are saying

The Ai Group’s *Survey of Workforce Development Needs 2014* addressed the issue of workplace literacy and numeracy. Specifically, the survey asked about the impact of poor literacy and numeracy skills on business and what measures have been used by workplaces to make improvements in this area. In relation to the impact of poor literacy and numeracy skills on business, employers reported the following:

Chart 5: Impact of poor literacy and numeracy on business



Over 93% of surveyed employers identified a wide range of impacts on their businesses. Only 6.6% of employers thought that this issue was not applicable to them. The most significant effects were:

- Poor completion of workplace documents or reports (41.86%)
- Material wastage (31.89%)

¹⁸ Engineering Apprentices: review of qualifications in engineering trades apprenticeships, Report to the Australian Workforce Productivity Agency, ACIL Allen Consulting, January 2014, pages 34, 66, 68.

- Teamwork and communication problems (28.24%)
- Time wasting (27.24%)

Many of these workplace issues are attributable to low level numeracy skills.

The Way Forward

The formation of the National Foundation Skills Strategy for Adults established the target of at least two thirds of working age Australians to have the literacy and numeracy skills needed to take full advantage of opportunities afforded by the new economy by 2022.¹⁹ This equates to Level 3 or above on the ALLS or equivalent standard of the PIACC.

There is a positive link between education and skill level of individuals and productivity outcomes for businesses. The Organisation for Economic Co-operation and Development (OECD) found in their *Better Skills, Better Jobs, Better Lives* report, that boosting skills is becoming increasingly important for nationwide economic prosperity.²⁰ Other OECD research shows that higher levels of literacy and numeracy contribute to increased productivity with positive correlation on GDP. Specifically, an increase of 1% in a country's literacy scores, relative to the international average, is associated with a 1.5% rise in GDP per capita and a 2.5% rise in labour productivity.²¹

The Productivity Commission has also established links between literacy and numeracy skills and labour market outcomes. An improvement in literacy and numeracy skills from level 1 to level 3 would increase the likelihood of labour force participation by 15% for women and 5% for men. It was also estimated that the same increase in LLN skills would increase hourly wage rates by 25% for women and 30% for men.²²

The National Foundation Skills Strategy advances a national public awareness campaign as a major focus. Within this a targeted workplace strategy is required and industry needs to be involved in the planning. This requires more effective targeting of priority workplaces. The current method of allocating funding to WELL projects is on a competitive grants basis rather than any notion of priority workplaces, or even industry sectors. For example, the ALLS survey data reveals that the manufacturing industry has a significant proportion of workers operating below the minimum required but this industry only received 18% of the WELL funding for 2007 – 2011.²³

The Foundation Skills Training Package has now been endorsed by the National Skills Standards Council.²⁴ The training package includes two Certificate I programs, one Certificate II and 91 units of competency which include 39 numeracy units. This is a valuable resource for LLN practitioners to utilise. It is important that Registered Training Organisations include this on their scope of delivery and commence implementation.

¹⁹ *National Foundation Skills Strategy for Adults*, Standing Council on Tertiary Education Skills & Employment, Commonwealth of Australia, September 2012.

²⁰ <http://skills.oecd.org/documents/OECDskillsStrategyFINALENG.pdf>

²¹ Coulombe, Tremblay & Marchand, 2004 *Literacy scores, human capital and growth across fourteen OECD countries*, Statistics Canada, Ottawa.

²² Shomos, A. *Links Between Literacy and Numeracy Skills and Labour Market Outcomes*, Productivity Commission Staff Working paper, 2010, Melbourne.

²³ *Strengthening Foundation Skills in the Workplace*, Final Report, 22 February 2012, Third Horizon, page 17.

²⁴ <http://training.gov.au/Training/Details/FSK>

More needs to be done to address the shortfall of qualified LLN practitioners in the Vocational Education and Training Sector. A government response to this has been the introduction of the LLN Practitioners Scholarships Program which provides financial assistance to enable practitioners to undertake LLN qualifications. Vocational Graduate Certificates and Diplomas have been undertaken through this initiative. The numbers are limited and in the first four years 297 scholarships have been awarded.²⁵ There is a need to significantly expand this program.

Standard 1 of the Standards for Registered Training Organisations (RTOs) 2015 requires RTOs to determine the support needs of individual learners, including LLN support²⁶. It states that RTOs must provide access to the educational and support services necessary for the individual learner to meet the training as specified in training packages or VET accredited courses. At minimum, the support should include identifying particular requirements, such as numeracy capabilities, that learners need to complete each course. To be compliant, RTOs must be able to demonstrate how this support has been made available.

A case study provided to guide RTOs includes a qualification requiring the ability to carry out complex calculations quickly and accurately. The RTO in the study provides this information on its website so potential learners are aware of the requirement. Information about optional tutorials is also included. As part of the RTO's enrolment process, learners undertake a short assessment based on the type of calculations they will need to be able to complete. Assessment results determine whether the learner will need additional support or whether further study should be undertaken before enrolling in the course.

Whilst these measures address LLN needs of learners commencing vocational programs, the capacity of VET practitioners to assist learners is in question. Some research has suggested that while VET practitioners appreciate the importance of workplace numeracy they lack the capacity in terms of their understanding of numeracy requirements and their qualifications, skills and experience.²⁷ One commentator has noted: "There is evidence of practitioner fear and lack of confidence in the face of students' numeracy needs."²⁸

Raising the LLN capability of the general VET workforce is a further challenge. Nationally recognised qualifications and skill sets are required to support the development of the VET workforce in this regard. Innovation and Business Skills Australia (IBSA), the relevant Industry Skills Council, is introducing important measures in this regard. A new skill set is under development to provide vocational practitioners with the skills and knowledge to address the LLN needs of their learners. In addition, the LLN elective in the Certificate IV in Training and Assessment program is mandatory from 2014 and will also be a core unit in the Diploma of VET.²⁹

²⁵ <http://www.innovation.gov.au/Skills/LiteracyAndNumeracy/LanguageLiteracyAndNumeracyPractitionerScholarshipProgram/Pages/default.aspx>

²⁶ Standards for Registered Training Organisations (RTOs) 2015 Users' Guide, Australian Skills Quality Authority, 2014.

²⁷ Tina Berghella and John Molenaar, *Seeking the N in LLN*, NCVET, 2013.

²⁸ Tout, David (2014) *Buried or not? What's happened to numeracy?* Research Developments, ACER.

²⁹ <http://rd.acer.edu.au/article/buried-or-not-whats-happened-to-numeracy>

²⁹ Innovation and Business Skills Australia, 2012, Skill set for addressing foundation skills in vocational practice.

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