



Providing World-Class School Education

Research Conference 2002

Proceedings

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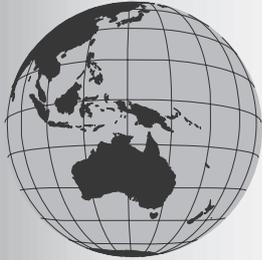
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Acknowledgements

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Foreword

Learning from International Achievement Studies

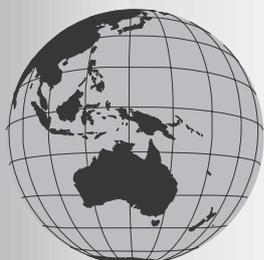
As a profession we are constantly learning how to improve educational outcomes for young people. Some of this learning occurs through teachers' day-to-day experiences and observations in classrooms; other learning occurs through the systematic study of student learning and the factors that influence it. Through this professional learning we are steadily building our knowledge about effective educational practices and policies—what works, for whom, and under what conditions. Dependable knowledge of this kind is essential to informed, evidence-based decision making in education.

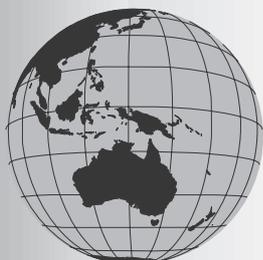
International achievement studies are making an important contribution to our growing professional knowledge base. They provide unique opportunities to enhance our understanding of what students are learning in different countries and of the factors that underlie differences in student achievement from country to country and from school to school. As John Keeves notes in his paper for this conference, international studies allow the investigation of differences that cannot always be found within any single country: for example, differences in teacher training arrangements, school curricula, the organisation of schools, and school resources. In this sense, international studies use the entire world as a natural 'laboratory' in which many different kinds of educational practices and policies can be found.

The public reporting of results from international achievement studies often goes no further than ranking countries by overall score. Which country topped the world in mathematics? How did Australia rank in science? How many countries performed better than Australia in civics and citizenship? The ability to benchmark performances in one country against achievement levels in other countries is an important benefit of international achievement studies.

However, the real professional learning opportunities in studies of this kind reside in efforts to understand why students across the world perform as they do. This question requires a thorough analysis of relationships between student achievement levels and the contexts in which learning takes place in different countries, including the roles of the home, school and classroom teaching in influencing learning outcomes. To maximise the opportunities for professional learning from international achievement studies it is necessary to carefully 're-search' the large volumes of data typically collected in these studies.

International achievement studies are capable of identifying international best practice in school education and providing decision makers at all levels—from policy maker to system manager to school leader to classroom teacher—with information that may be useful in their own efforts to improve student learning outcomes. These studies assist us in answering such questions as: What is 'world-class' education? and What characterises outstanding educational provision?





Beyond this, international achievement studies are playing an important role in setting best-practice standards for the monitoring and study of educational outcomes. Over the decades in which they have operated, international studies have set best-practice standards in implementing modern measurement and research methodologies. As Peter Fensham notes in his paper, through its use of 'authentic stories', PISA has developed new forms of science testing capable not only of providing more complete and reliable understandings of students' scientific literacy knowledge and skills, but also valuable diagnostic information. In many countries, including Australia, state and national assessment programs have been strengthened by adopting methodologies developed and implemented in international achievement studies.

In summary, international achievement studies play an important role in our ongoing professional learning by providing opportunities to:

- benchmark student achievement against performances in other countries;
- develop improved understandings of the impact of countries' educational policies and practices on student learning; and
- implement and model international best practice in the assessment of student learning and in the investigation of factors influencing educational outcomes.

As Juliette Mendelovits observes in relation to the PISA Reading Literacy study, this kind of professional learning is not always the stuff of headlines. The real impact of the PISA Reading Literacy study is now occurring through subtle and long-term changes to the way we think about, measure and teach literacy in Australia.

Geoff N Masters
CEO



Summaries of conference papers

1. Plenary papers

This section of the conference proceedings includes summaries of all papers. It should be noted that these papers are summaries, and may not cover all the content in the full version of the paper as presented at the conference.

The IEA International Civic Education Study: Australian results

Judith Torney-Purta

Judith Torney-Purta holds a BA from Stanford University (Psychology) and a PhD from the University of Chicago (Human Development). She has been Professor of Human Development in the College of Education at the University of Maryland at College Park since 1981, moving there from the University of Illinois at Chicago where she was Professor of Psychology. She is also Affiliate Professor of Public Affairs at Maryland. She was recently awarded the Nevitt Sanford Prize by the International Society for Political Psychology. Her long-term research interest has been developmental and educational psychology, especially as it can be applied to political socialization and the civic engagement of youth. Her first book, *The Development of Political Attitudes in Children*, was published in 1967. Since 1994 she has served as the Chair of the International Steering Committee of the Civic Education Study of the International Association for the Evaluation of Education Achievement (IEA), Amsterdam. Phase 1 of this study included the development of case studies and the content framework on which the test and survey were based. *Civic Education Across Countries: Twenty-four National Case Studies from the IEA Civic Education Project* (Torney-Purta, Schwille & Amadeo, 1999) was designated by the American Library Association as an Outstanding Academic Book (the Choice Award). During Phase 2 of the IEA study, representative samples totaling 140,000 respondents at two age levels were surveyed. A total of four books and six articles and chapters about the Phase 2 test and survey has been published or are in press.

Major support for Phase 1 of the IEA study came from the Pew Charitable Trusts. Major support for Phase 2 came from the German Science Foundation (DFG) to the Humboldt University of Berlin, and from the William T Grant Foundation to the University of Maryland. The report of Phase 1, *Civic Education Across Countries: Twenty-four National Case Studies from the IEA Civic Education Project*; the report from the testing of 14-year-olds that took place in 1999 entitled *Citizenship and Education in Twenty-eight Countries: Civic Knowledge and Engagement at Age Fourteen* (Torney-Purta, Lehmann, Oswald & Schulz, 2001); and the report of data from the upper secondary population of 17–19 year olds, *Civic Knowledge and Engagement at the Upper Secondary Level in Sixteen Countries* (Amadeo, Torney-Purta, Lehmann, Husfeldt & Nikolova, 2002) can be ordered from department@iea.nl or fax 31 20 420 7136. The text of the Phase 2 reports are on the study's Web page (www.wam.umd.edu/~iea/), along with the instruments and references to publications reporting more in-depth analysis (for example, an article in the September 2001 issue of *Prospects* and an article in *Applied Developmental Science* on the role of the school). The Web site also contains details of the release of data for analysis by other researchers late in 2002, and links to national reports.

The goal of the IEA Civic Education Study, with data collected in 1999 and 2000 from a total of 140,000 young people in two cohorts of 14 and 16–19 year olds from a total of 29 countries, has been to examine in a comparative framework the political socialization of adolescents as they prepare to undertake their roles as citizens in democratic society. Since the 1970s, through to the 1990s, only a few international comparative studies of young people were undertaken (Torney, Oppenheim & Farnen, 1975; Flanagan et al, 1998; Hahn, 1998). Many gaps in our understanding of this important process can be filled by analysis of the IEA Civic Education Study's data. National teams (for Australian data, Suzanne Mellor and Kerry Kennedy) are conducting much of this analysis.

This paper will focus on a description of the Australian results from 14-year-olds in comparison with many of the other 27 countries that tested 14-year-olds in 1999, with special attention to the two other English-speaking countries that participated – England and the United States. These analyses will be summarised under the following topics:

- *Centrality* of content knowledge, skills in interpreting political information and concepts of democracy;
- *Differentiation* in modes of participation in democracy and especially what influences them in and outside the school;
- *Commonality* in perceptions of the ideal of pedagogical practice and how factors such as classroom climate and explicit focus on particular topics influence different aspects of participation;
- *Solidarity* as an aim of schooling and as part of the school culture that is influential in shaping participation.

In the IEA Civic Education Study an attempt has been made to move beyond the earlier socialization research, which might be described as the 'who done it' model (that is, looking at sources operating in an isolated and top-down fashion rather than interactively). Thus, an 'Octagon' model was developed by the study's National Research Coordinators in order to conceptualise the ways in which the individual student, who is at the center of the civic education process, is embedded within a series of face-to-face interactions and more distant systems of discourse and institutions.

Further to this, recent theorizing in psychology suggests other linkages. Socio-cultural theories, such as the situated cognition view of Lave and Wenger (1991), speak of the various groups to which young people are related as 'situating' their learning or cognition and use the term 'legitimate peripheral participation' to describe the observation by, or partial participation of, individuals who are young or relative

newcomers. In a more recent formulation, Wenger (1998) has detailed some ramifications of a notion of 'communities of practice', or overlapping membership groups ranging from work teams to community organisations to classrooms. In these groups individuals negotiate identities, acquire knowledge and skills that are meaningful as defined by the group, and are engaged in practice. Through experience that is either intentionally or unintentionally shaped and 'scaffolded' by older group members, they gradually move away from peripheral participation to more central involvement.

The feeling of confidence in one's own abilities to influence both individuals and institutions involves a constellation of competencies studied for many years by those specializing in political science using the concept of 'political efficacy'. This concept is also important in the psychological theory of Bandura (2001), who has discussed the 'sense of self-efficacy' and, more recently, 'collective efficacy'. The common core of efficacy is belief in one's ability to accomplish goals one has chosen (in the case of political efficacy the goal of improving the community or influencing governmental or political action). The concept of collective efficacy adds the idea that joining with a group to take action is often more effective than taking action by oneself. This work provides a new convergence point for studies by psychologists and political scientists.

The Octagon, socio-cultural theory, concepts of identity and of efficacy were central in developing the IEA Civic Education Study, a 1999 test and survey of more than 90,000 14-year-olds in 28 countries whose data provides the empirical basis for this presentation.

A description of the IEA Civic Education Study

In the early 1990s, the International Association for the Evaluation of Educational Achievement (a comparative education association of nearly 60 member countries with headquarters in Amsterdam) began exploring the subject area of civic education in order to develop a measuring instrument, and conduct a test and survey, of young people using some of the recent methodological innovations used in studies such as the Third International Mathematics and Science Study (TIMSS). The IEA Civic Education Study was designed in two phases, one more qualitative and the other more quantitative. Phase 1 utilised teams of researchers in each country, who outlined the expectations countries had for adolescents in civic-related subjects. Another purpose of this phase was to reach consensus among member countries about a common core of content about the fundamental principles of democracy and citizenship that might be assessed. Case studies concerning the expectations for learning about civic-related subjects by 14-year-olds were formulated within

each of 24 participating countries, including Australia (Torney-Purta, Schwille & Amadeo, 1999). After a cross-national consensus building process of about three years, a considerable amount of agreement about a core set of expectations for civic education was achieved. Knowledge about democracy and its principles, sense of engagement and willingness to participate, legitimacy or attitude of trust in government, and attitudes about the rights of various groups to participate were all discussed in these case studies and formed the basis for the test and survey that comprise Phase 2 of the IEA Civic Education Study.

The IEA Civic Education researchers engaged in a three-year process of development, involving research co-ordinators from more than 20 countries and two pilot tests, to arrive at an instrument suitable for class administration across countries, with clearly formulated items for translation into 20 languages. Fourteen-year-olds were tested because that was the last year of compulsory school in some countries wanting to participate.

These testing materials were elaborated during meetings of National Research Coordinators. The instrument included three core domains: 'Democracy, democratic institutions and citizenship'; 'National identity and international relations'; and 'Social cohesion and diversity'. These domains were elaborated into a Content Framework using the Phase 1 national case study documents. The framework contained many topics from debates about building, consolidating and maintaining democracies, for example, incentives to participate in democracy, problems in transitions of government, characteristics and functions of elections and parties, citizens' rights, civic duties and obligations, and the role of organisations in civil society. This framework of concepts formed the basis for constructing the test measuring civic knowledge and skills in interpreting political information (and may be found in the Appendix of Torney-Purta, Lehmann, Oswald & Schulz, 2001). The knowledge test was selected from a pool of 140 items and included 38 items measuring content knowledge (in the three domains described). This test was developed with Item Response Theory (IRT) scaling, providing a psychometrically strong instrument. Twenty-five of these test items measured content knowledge (relating to democratic governmental structures, citizenship, international organisations, and social diversity), while 13 measured skills in interpreting civic information (eg, a political leaflet, political cartoons, a mock newspaper article). All were suitable for use across countries. The IEA instrument also included a measure of concepts of democracy, concepts of the good adult citizen, and concepts of the social and economic responsibilities of government (as well as attitudinal scales and items about the intent to participate in various civic and political behaviours).

The test and survey were administered in 1999 to nationally representative samples of students in the modal grade for 14-year-olds totalling 90,000 students (see IEA standards in Martin, Rust & Adams, 1999).¹ The European countries participating in Phase 2 were Belgium (French), Bulgaria, Cyprus, the Czech Republic, Denmark, England, Estonia, Finland, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Norway, Poland, Portugal, Romania, the Russian Federation, the Slovak Republic, Slovenia, Sweden and Switzerland. In addition, Australia, Chile, Colombia, Hong Kong (SAR) and the United States participated. The report of the results of Phase 2 (Torney-Purta, Lehmann, Oswald & Schulz, 2001) presents figures that detail the position of each country's students as 'significantly above', 'at' or 'below' the international mean. A testing of older students (aged 16–19) took place (mainly in 2000) in 16 countries (not including any English-speaking countries). The test was augmented to include some harder items, including a number measuring economic literacy. The survey was substantially the same as for the 14-years-olds. The results, including differences between age groups, appear in Amadeo, Torney-Purta, Lehmann, Husfeldt and Nikolova (2002).

Design issues and results

Extent of centrality of content knowledge and concepts

There was a debate among those designing the instruments about how much emphasis should be placed on knowledge and how much time devoted to questions with right and wrong answers. In the end, about only half the testing time was taken up with this type of question.

On the knowledge test, as a whole, Australian 14-year-olds performed at a level that was not significantly different from the international mean of 100; their score was 102. Of even greater interest, however, was that Australian students' performance on the items assessing skills in interpreting political information was significantly above the international mean (107), very similar to the students in England (105), and somewhat similar to those in the United States (114). In contrast, students in the three English-speaking countries had scores on the subscale measuring content knowledge of democratic concepts and principles that were either at the international mean (in the case of Australia and the United States) or below the international mean (in the case of England). (Specific examples in the presentation.)

In addition to questions with right and wrong answers there were items with considerable cognitive content

concerning students' concepts of democracy (for example, asking students to rate whether something would be bad or good for democracy). In some respects there were similarities and in others differences in the concepts of democracy held by Australian students and those in other English-speaking countries (to be elaborated in the presentation).

Differentiation in modes of engagement

Some educators differentiate between 'political engagement', usually meaning the activities conventionally associated with adult citizenship in relation to political institutions, and 'civic engagement', a broader term including participation in activities to benefit the community without any necessary connection to political institutions. To name a few types of engagement – voting, voting after seeking information about candidates or issues, participating in discussion of political issues, affiliating with a political party, or a wider range of participation (including both activities conventionally associated with adults who are engaged in politics and also what is called social movement participation). These activities also vary in the extent to which there is a potential for conflicting opinions (most substantial in protest and partisan activities, somewhat less likely for voting and least likely for volunteering).

Even though multiple modes of participation are available to adolescents, the range of activities and levels of involvement accessible to them is somewhat limited. For example, adolescents may participate in an adult election campaign but are unlikely to hold decision-making positions. It is therefore important to consider organisations where adolescents have the opportunity to engage in leadership activities, such as a student council or parliament or a community or school organisation.

The IEA study's basic analysis found that many aspects of participation were related but the differences between them were also worth examining. The norms 14-year-olds hold concerning the importance of adults' political activities were assessed. Measures of students' concepts of norms for the 'good' citizen in conventional political terms (voting, participating in political parties or discussions) and in terms of participation in social movement activities (belonging to environmental or groups volunteering to benefit the community) were developed. It was clear that young people in the late 1990s believed that citizens should vote and obey the law, but apart from those activities they were more supportive of social movement activities than of conventional political activities such as political party membership or discussing issues (see Torney-Purta, Lehmann, Oswald & Schulz, 2001).

¹In the IEA Civic Education Study each sampled school also surveyed three teachers of civic-related subjects (often history or social studies) that were teaching the tested class of students.

In order to explore these issues in more depth, four different aspects of expected adult participation were chosen: one distinctly related to political institutions and likely to be encouraged by schools (voting after getting information about candidates); one distinctly political and conflictual but not likely to be discussed in school (joining a political party); one with civic rather than political dimensions and likely to be encouraged by schools in some countries (volunteering time to help the community); and one with considerable conflict potential and related to social movements (participating in a non-violent protest march).

What follows is a summary of the correlates of two of these aspects of expected adult participation – informed voting and volunteering (with additional detail to be provided in the presentation). Voting (in this case informed voting) is influenced by all aspects of the school and by knowledge acquired there. Civic knowledge is especially important.² The confidence students gain about their ability to participate with other students, and the emphasis on elections and voting implemented as part of the curriculum are also important (although the curriculum is a slightly less important influence in Australia). Presence of an open classroom climate encouraging discussion is also a significant predictor across the three English-speaking countries, although it is a little stronger in Australia. Discussion with parents is important, especially in Australia. General organisational participation makes a small contribution, while participation specifically in a school parliament or council does not have an influence in any of the three countries. Religious participation makes a small positive contribution to the likelihood of informed voting in the United States but has a negative relation in Australia. Trust in government-related institutions and political interest make moderate contributions. In summary, school-related factors appear to play an important role in promoting students' stated willingness to vote in an informed way with similar, though not identical, patterns in the three English-speaking countries.

In contrast, civic knowledge is not a significant predictor of the intent to volunteer in England and the United States. In Australia it is actually the less knowledgeable students who are likely to think that they will become volunteers. However, learning in school about community problems that might be addressed by volunteering impacts the perceived likelihood that one will be involved as an adult volunteer. Specific current experience with an organisation giving service to the community, along with general confidence in the efficacy of getting together to take action in groups that are close to them (eg, with other students in their schools), are both important. Participation in discussion with parents also plays a role, as does participation in classroom discussion and in organisations generally. There is little

evidence that volunteering has much connection to political issues, since neither trust in government nor political interest has much impact on participation through volunteering. In this area, some aspects of schooling (though not political knowledge, per se) and out-of-school community experiences are important in promoting willingness to be an adult volunteer.

Additional information about the correlates of expected partisan membership and of willingness to participate in a non-violent demonstration will be included in the presentation. It will also deal with commonalities in pedagogical practice and with solidarity, and will draw some conclusions about the particular situation of students and of civic education in Australia.

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²In Australia this may be especially likely to be transmitted in history or social science courses.

Learning from international studies of teaching: the TIMSS-R Video Study

James Hiebert and Hilary Hollingsworth

James Hiebert is the Robert J Barkley Professor of Education at the University of Delaware, where he teaches in programmes of teacher preparation, professional development and doctoral studies. His professional interests focus on mathematics teaching and learning in classrooms. He has edited books entitled *Conceptual and Procedural Knowledge: The Case of Mathematics and Number Concepts and Operations in the Middle Grades*, and co-authored *Making Sense: Teaching and Learning Mathematics with Understanding and The Teaching Gap: Best Ideas from the World's Teachers for Improving Education in the Classroom*. He currently serves on the National Research Council committee Mathematics Learning Study, is the director of the mathematics portion of the TIMSS-R Video Study, and is Principal Investigator on the, National Science Foundation-funded, Mid-Atlantic Center for Teaching and Learning Mathematics. He received a BA and MA in mathematics, taught mathematics in high school and then earned a PhD in mathematics education at the University of Wisconsin-Madison.

Dr Hilary Hollingsworth is a Senior Researcher and Director of Teacher Learning at LessonLab Learning at LessonLab Inc in Los Angeles, California. For the past three and a half years she has been the representative for ACER working on the Third International Mathematics and Science Study – TIMSS-R Repeat Video Study. In that position she has shared responsibility for the development, implementation and analyses of the videodata coding scheme, the authoring of the international report, *Mathematics Teaching in Seven Countries: Results from the 1999 TIMSS-R Video Study*, the authoring of the TIMSS-R Video Study Public Release lessons, and the authoring of the Australian report. In addition to her research role in the TIMSS-R Video Study, she works with school systems, school districts, universities, professional development organizations and textbook publishers across the United States as a Director for the Teacher Learning Division of LessonLab. This work involves the design and implementation of video cases in a unique and powerful Web-based technology platform. She has published papers related to her research in teacher professional development, as well as resource books for teachers and parents. The research reported here is the work of a large international team. It is the joint effort of our colleagues in the mathematics research team at LessonLab Inc, together with national research coordinators, specialist consultants and teachers in the participating countries of the TIMSS-R Video Study.

Background and goals of the TIMSS-R Video Study

The 1999 Third International Mathematics and Science Study-Repeat (TIMSS-R) Video Study was a successor to the 1995 Third International Mathematics and Science Study (TIMSS) Video Study. The 1999 TIMSS-R Video Study expanded on the earlier 1995 TIMSS Video Study by investigating eighth-grade teaching in science as well as mathematics and sampling classroom lessons from more countries. Although data were collected at the same time, the mathematics and science portions of the 1999 TIMSS-R Video Study are treated separately and only mathematics will be discussed in this paper.

The broad goal of the mathematics portion of the 1999 TIMSS-R Video Study was to investigate and describe teaching practices in eighth-grade mathematics in a variety of countries, including those with varying cultural traditions and with high mathematics achievement as measured in the 1995 TIMSS Achievement Study. The 1995 TIMSS Video Study included only one high achieving country – Japan. It was tempting for some audiences to draw the premature conclusion that high achievement is possible only by adopting teaching practices like those observed in Japan. The 1999 TIMSS-R Video Study addressed this issue by sampling lessons in more countries whose students performed well on the 1995 TIMSS achievement study.

Countries participating in the 1999 TIMSS-R Video Study were Australia, the Czech Republic, Hong Kong

SAR,¹ the Netherlands, Switzerland and the United States. Japan did not participate in the mathematics portion of the 1999 TIMSS-R Video Study, however the Japanese mathematics lessons collected for the 1995 TIMSS Video Study were re-analysed. TIMSS achievement test scores for the participating countries are seen in Table 1.

In addition to the broad goal of describing mathematics teaching in seven countries, including a number of countries with records of high achievement, the 1999 TIMSS-R Video Study had the following research objectives:

- To develop objective, observational measures of classroom instruction to serve as appropriate quantitative indicators of teaching practices in each country;
- To compare teaching practices among countries and identify similar or different lesson features across countries; and
- To describe patterns of teaching practices within each country.

Design and methods

The 1999 TIMSS-R Video Study was designed to describe eighth-grade mathematics teaching in each participating country. The design included some unique features best described by the label 'video survey'. The concept is to marry videotaping (heretofore used mostly on a small scale for qualitative analysis) with national sampling (commonly used in survey research). Video surveys allow researchers to

¹For convenience, in this report Hong Kong SAR is referred to as a country. Hong Kong is a Special Administrative Region (SAR) of the People's Republic of China.

integrate the qualitative and quantitative study of classroom teaching across cultures, increasing their chances of capturing not only powerful universal quantitative indicators but culturally particular qualitative categories as well.

The TIMSS-R Video Study sought to provide national-level pictures of teaching. Consequently, it was important to maximize the number of teachers participating, even though this meant videotaping each teacher, teaching a single classroom lesson, only once. Furthermore, to get a nationally representative picture of eighth-grade mathematics teaching, lessons were randomly selected across the school year. Different countries use different curricula and move through different sets of topics. The only reasonable way to deal with this variation is to sample steadily across the school year and to randomly select lessons at each point. The sample size and participation rate for each country in the TIMSS-R Video Study can be seen in Table 2.

Once collected, the videotapes were coded. Most codes were developed and later applied by international teams whose members were cultural insiders. All coders were fluent in the language of the lessons they coded. However, not all of them were experts in mathematics or teaching. Therefore, several specialist coding teams with different areas of expertise were employed to create and apply codes for special aspects of the mathematical nature of the content, the pedagogy, and the discourse.

What can we learn through international studies of teaching using video?

Why undertake such an expensive and labor intensive study of teaching involving the collection and analyses of hundreds of hours of videotaped classroom lessons from all over the world? There are at least five reasons. First, studying teaching can lead to improvements in what and how well students learn. Although research suggests it is difficult to draw clean and direct connections between teaching and learning, there is little doubt that teaching affects learning. The more educators learn about teaching, the more they learn about providing effective learning opportunities for students. So, although no empirical links can be drawn between teaching and achievement levels in the participating countries, the comparative descriptions of teaching in seven countries afford unprecedented analyses of teaching.

Second, examining teaching in different countries reveals one's own teaching practices more clearly. When everyday routines and practices are so culturally

common that most people do things in the same way, they can become transparent and invisible (Geertz, 1984). To the extent they are noticed, everyday practices can appear as the natural way to do things rather than choices that can be re-examined. A powerful way to notice the practices of one's own culture is by observing others. This is a principal aim of cross-cultural, comparative research (Ember & Ember, 1998; Whiting, 1954).

Third, looking at other cultures might not only help to see oneself more clearly, it might also suggest alternative practices. Although variation exists within cultures, truly distinctive methods of teaching are, by definition, the exception. By stepping outside one's own culture, chances can increase for seeing something new.

Fourth, a cross-cultural examination can stimulate discussion about choices within each country. Alternative practices, discovered in other countries, might not transpose readily across cultures. They might be based on cultural conditions that do not exist elsewhere. But, seeing oneself more clearly by comparing practices across cultures, and seeing alternative practices that can generate new ideas for practices at home, can prompt the following useful response: classroom practices are the result of choices; they are not inevitable. Given this fact, and given the alternatives that are revealed, questions can be asked about whether the choices that have been made in the past are the most appropriate for the current instructional goals.

Finally, cross-cultural studies help deepen educators' understanding of teaching. They provide information about different systems or methods of teaching and different ways in which the basic ingredients of teaching can be configured (Stigler et al, 2000). Descriptions of contrasting methods can help researchers construct more informed hypotheses about teaching and about how different methods of teaching might influence learning.

Using the results of international video survey for research and professional development²

A significant challenge of any large-scale study of teaching is communicating the results. Teaching is a complex activity, and analysing the teaching in hundreds of hours of videotapes can yield a complicated mass of data. Fortunately, the advantages of video data do not end with the analysis. Video can be used to convey a much richer story than words and numbers alone.

²The results of the 1999 TIMSS-R Video Study are not yet available. It is expected that they will be released by early 2003 and published in a National Center for Education Statistics report: Hiebert et al (in press) *Mathematics Teaching in Seven Countries: Results from the 1999 TIMSS-R Video Study*.

Video can provide visual, concrete definitions for abstract research terms and give life to research results. Quantitative data and video examples work hand-in-hand to present a more complete and reliable picture than either could achieve by itself. Videos are extremely powerful communicators and create lasting images that can be helpful if appropriate, or misleading if aberrations. Quantitative results document the way in which the video images are, or are not, representative of the full sample of teaching.

Public Release videos from all participating countries were collected to accompany the written report for the TIMSS-R Video Study. These videos serve two purposes. First, they help present the findings from the study, and the methods that were used. For example, clips from these videos illustrate the definitions for the categories used for coding and analysing the videos. This provides readers of the report and viewers with a better sense of the codes used to generate the results and, in turn, a more meaningful basis for interpreting the results.

Video lessons can also provide teachers with new ideas and can stimulate deeper discussions about choices that can be made in designing lessons. A further purpose of the public release videos is to give educators access to a new source of ideas on how to teach common topics of eighth-grade mathematics, and to encourage educators to re-examine their own practices in light of these alternatives.

Hopefully, this video study will launch a deeper and more widespread international discussion among educators about the options available for teaching mathematics. Perhaps the greatest contribution of this work will be the establishment and growth of an international community of teachers, administrators, and researchers dedicated to the proposition that the study and improvement of classroom teaching can and should be a collective professional enterprise.

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Table 1: TIMSS-R Video Study participating countries and their average score on the 1995 TIMSS and 1999 TIMSS-R mathematics assessments

Country	TIMSS mathematics score		TIMSS-R mathematics score	
	Average	Standard error	Average	Standard error
Australia *	519	3.8	525	4.8
Czech Republic	546	4.5	520	4.2
Hong Kong SAR	569	6.1	582	4.3
Japan	581	1.6	579	1.7
Netherlands *	529	6.1	540	7.1
Switzerland	534	2.7	–	–
United States	492	4.7	502	4.0

* Nation did not meet international sampling and/or other guidelines in 1995. See Beaton et al (1996) for details.

NOTE: Rescaled 1995 TIMSS mathematics scores are reported here. Switzerland did not participate in the 1999 TIMSS-R assessment.

SOURCE: Gonzales, P., Calsyn, C., Jocelyn, L., Mak, K., Kastberg, D., Arafeh, S., Williams, T. & Tsen, W. (2000). *Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a US Perspective, 1995 and 1999*. National Center for Education Statistics, US Department of Education, Washington, DC.

Table 2: Sample size and participation rate for each country in the TIMSS-R Video Study

Country	Number of schools that participated	Percentage of schools that participated including replacements ¹ – unweighted ²	Percentage of schools that participated including replacements ¹ – weighted ³
Australia	87	85	85
Czech Republic	100	100	100
Hong Kong SAR	100	100	100
Japan ⁴	50	100 ⁵	100 ⁵
Netherlands	85 ⁶	87	85
Switzerland ⁷	140	93	93
United States	83	77	76

¹ The participation rates including replacement schools is the percentage of all schools (ie, original and replacements) that participated.

² Unweighted participation rates are computed using the actual numbers of schools and reflect the success of the operational aspects of the study (ie, getting schools to participate).

³ Weighted participation rates reflect the probability of being selected into the sample and describe the success of the study in terms of the population of schools to be represented.

⁴ Japanese mathematics data was collected in 1995.

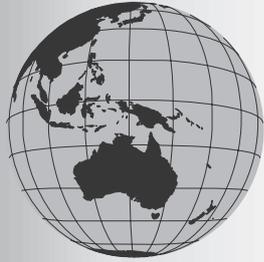
⁵ The response rates after replacement for Japan differ from that reported previously (eg, Stigler et al, 1999). This is because the procedure for calculating response rates after replacement has been revised to correspond with the method used in the 1994–1995 TIMSS and 1998–1999 TIMSS-R Achievement Studies.

⁶ In the Netherlands, a mathematics lesson was filmed in 78 schools.

⁷ In Switzerland, 74 schools participated from the German-language area (99 per cent unweighted and weighted participation rate), 39 schools participated from the French-language area (95 per cent unweighted and weighted participation rate), and 27 schools participated from the Italian-language area (77 per cent unweighted and weighted participation rate).

NOTE: For Australia, the Czech Republic and the Netherlands, these figures represent the participation rates for the combined mathematics and science samples.

SOURCE: US Department of Education, National Center for Education Statistics, *Third International Mathematics and Science Study-Repeat, Video Study*, 1999.



2. Concurrent papers

PISA from Australia's perspective

Jan Lokan

Dr Jan Lokan began a long career in education as a secondary mathematics teacher, soon becoming a lecturer in mathematics, statistics and research methodology at tertiary level. She moved from Australia to Canada in 1968, leaving teaching for a full-time position in educational research with the Ottawa Board of Education, beginning as a developer of mathematics assessment materials for research projects in Ontario schools. On returning to Australia in 1978, she took up an appointment at ACER, undertaking mostly survey studies with a wide range of purposes: instrument development and validation; program evaluation; curriculum implementation; career development of secondary students; and large-scale studies of student achievement.

Jan has had extensive involvement in international studies. She directed the Australian components of the international *Work Importance Study* (led by Professor Donald Super of Teachers College Columbia University in New York); the *Third International Mathematics and Science Study* (TIMSS); the *TIMSS-Repeat Video Study*; and the first cycle of the OECD *Programme for International Student Assessment* (PISA). She has served on several international committees in connection with these studies and was also part of the international management team for PISA, which was coordinated from ACER. She has published several books, book chapters and articles related to these studies.

At the time of her retirement in December 2001, Jan was Deputy Head of ACER's Measurement Division.

In 2000, along with more than a quarter of a million similar-aged students from 31 other countries, just under 6,200 Australian teenagers took part in the first Programme for International Student Assessment (PISA) survey. In all countries the students comprised national random samples of students aged between 15 years 3 months and 16 years 2 months at the time they were assessed. In Australia, they were sampled from all states, territories and education sectors. Development of the survey tests and questionnaires began in 1998, and the survey itself occurred between February and May 2000 in the northern hemisphere and between July and October 2000 in the southern hemisphere. Twenty-eight of the participating countries were OECD member countries. Non-OECD countries involved were Brazil, Latvia, Liechtenstein and the Russian Federation.

PISA is an initiative of the Organisation for Economic Co-operation and Development (OECD) in Paris, which was keen to have measures of outputs from compulsory level schooling to accompany its regularly collected country-level data on education contexts and investments of human and monetary resources in education. Each year the input data are featured in the OECD's publication, *Education at a Glance*. PISA is planned to occur every three years, to provide measures of 15-year-old students' skills on a regular basis and to enable trends in performance to be monitored over time. PISA is implemented internationally by a consortium led by the Australian Council for Educational Research (ACER), which also manages the survey within Australia under the guidance of a National Advisory Committee.¹

Goals and features of PISA

PISA is forward-looking, being primarily concerned with how well students are likely to cope with their lives in the future rather than with how much of their formal curricula they have learned. It asks policy-relevant questions of a broader nature:

- How well prepared are young people to deal with the challenges they will meet in the future?
- What skills do young people have that will help them adapt to change in their lives? Are they able to analyse, reason and communicate their ideas effectively? Do they have the capacity to continue learning throughout life?
- Are some ways of organising schools and school learning more effective than others in helping students to develop such skills?
- What influence does the quality of school resources have on students' learning?
- To what extent is students' performance dependent on their home backgrounds?
- Do the results point to ways in which school systems can be made more equitable for all students?

Data to facilitate answers to these questions were collected from students and school principals through comprehensive questionnaires and specially prepared tests in the domains of reading, mathematics and science, defined in a broad way as 'literacies'. All instruments were developed through a highly collaborative process by the countries participating in the survey.

PISA is an unprecedented attempt to measure student skills across participating countries, as is evident from the following features:

- *Its 'literacy' approach:* PISA defines each main assessment domain (reading, mathematics and science) not merely in terms of mastery of the school curriculum, but in terms of important knowledge and skills needed for full participation in society;²
- *Its long-term commitment:* spanning at least the decade to come, PISA will enable countries to monitor their progress in meeting key learning objectives;

¹ The Commonwealth, State and Territory governments fund the Australian component of PISA.

² Other papers in this volume present the definitions and discuss the scope of PISA's three main domains, which are therefore not included here.

- *The age group covered:* assessing young people near the end of their compulsory schooling provides a significant indication of the performance of education systems; and
- *Its relevance to lifelong learning:* PISA does not limit itself to assessing the knowledge and skills of students but also asks students to report on their own, self-regulated learning, their motivation to learn and their preferences for different types of learning situations.

Scope of PISA in Australia

Altogether, 231 of the 246 randomly selected Australian schools participated in the survey. This constitutes a school response rate of 94 per cent, unprecedented in similar large-scale achievement surveys in Australia. The response rate was uniformly good throughout the states and territories. The numbers of schools participating from each system were: NSW, 40; Victoria, 34; Queensland, 35; SA and WA, 29 each; Tasmania, 24; Northern Territory, 17; and ACT, 23. Schools in Tasmania, the NT and the ACT were oversampled to enable state-based as well as national reporting of results. Australia-wide, two thirds of the schools were government schools, about a fifth were Catholic schools and a little less than a sixth were independent schools. About two-thirds of the 231 schools were from large urban areas, a further quarter were from towns with populations of 15,000 to 100,000, and the remainder were from smaller country towns.

The main achieved sample comprised 5,176 students. An additional 301 Indigenous students were assessed to enable accurate reporting of results for this student sub-group. Sampling weights were used in determining national and state results so that the numbers of students by state and sector reflected the proportions in the total population in each case.

Australian perspectives on PISA 2000 results

Some highlights of results, indicative of the overall picture, are summarised here. More results will be illustrated and discussed in the presentation.

Overall results in main assessment domains

Australian students, on the whole, performed consistently very well in all three of the main assessment domains. Only one country achieved a better result than Australia in each of reading (Finland) and mathematics (Japan), and only two countries achieved a better result in science (Korea and Japan).

The comparative results from Australia's perspective are presented in Figures 1 to 3. The country results in each case were estimated from a random sample and show the mean and 95 per cent confidence range (the band in which country results would be expected to fall 95 per cent of the time if random samples of students were repeatedly drawn from the same target population). The figures show that there are very few countries anywhere in the world where 15-year-olds are provided with reading, mathematical and scientific literacy skills above those being achieved in Australia.

Within Australia, comparisons between the state and territory results showed more similarities than differences. All the state and territory results were at or above the OECD average.

Descriptions of five levels of reading proficiency measured in PISA were prepared by an international committee of reading experts. This was done so that results could be presented in a more informative way than merely reporting means and statistical distributions.³ The overall results according to percentages of students at each proficiency level are shown in Figure 4. On average, 10 per cent of students demonstrated the top level of proficiency, being able to understand complex texts, evaluate information and develop hypotheses, and draw on specialised knowledge. In Australia, Canada, Finland, New Zealand and the UK, the percentages of students at the top level ranged from 15 to 19. At the other end, the percentage of Australian students who could not do tasks beyond Level 1, at 9 per cent, was only half the OECD average. Students at this level show serious gaps in their foundation reading literacy skills, impairing their ability to benefit from further schooling or workplace training.

The Australian students' achievements and their distribution by reading proficiency level within states and territories will be illustrated and discussed in the presentation.

Sub-group results in main assessment domains

In every country that took part in PISA, girls were, on average (and usually also at the highest proficiency level), found to be better readers than boys. Even in the high achieving countries, boys were more likely than girls to be at Level 1 or below in reading proficiency. In about half the countries, but not Australia, boys outperformed girls in mathematical literacy. Australia, along with 25 other countries, also had no gender difference in scientific literacy (in three countries girls outperformed boys and in a further three, boys outperformed girls).

³ See the paper by Mendelovits in this volume for details of the proficiency levels.

In all countries, students who spoke a language other than the language of the test at home most of the time had lower mean reading literacy scores than students who spoke the language of the test. However, in Australia the discrepancy between these two groups in reading literacy was smaller than in any other country, and there was no discrepancy in their mathematical literacy scores. The country percentages of non-test-language speakers varied from about two per cent in Finland, Iceland, Portugal and Spain to 20 per cent in Liechtenstein. In Australia, 17 per cent of students came from households where English was not the main language spoken.

The performance of Australian Indigenous students in each of reading, mathematical and scientific literacy was considerably lower than the performance of non-Indigenous students.⁴

Overall results in other domains

Use of appropriate strategies for learning, and possession of positive attitudes to learning information technology and self-improvement, are also relevant to coping in life beyond school. It is encouraging that only five per cent of the girls and eight per cent of the boys in the Australian PISA sample had no intention of continuing their education beyond school, and two-thirds of the girls and almost 60 per cent of the boys intended to complete at least an undergraduate university degree (this question was not included in other countries' questionnaires).

Three kinds of learning strategies were measured, as an indication of how well students would be able to manage their own learning in the future. The strategies were: the extent to which students *controlled* their own learning – for example, by setting goals and priorities; the extent to which they used *elaboration* strategies – for example, by making the effort to integrate new learning with things they already knew; and the extent to which they learned by *memorising*. The Australian students were at the OECD average except for memorising, on which they were substantially above the OECD average. All of the learning scales were positively related to achievement, but the deeper strategies of controlling and elaborating were more strongly related.

Australian students' attitudes to school and to reading in particular were relatively low. Close to a quarter of the students said that school was a place where they did not want to go. This was not unique, but the level of negativity towards school in Australia was higher than the OECD average. 'Engagement with reading' was the most highly correlated of the attitudinal variables with reading achievement. Australian students' result on this scale was at the OECD average overall, but there was a predictable gender difference that gives rise to concern.

School and background factors

PISA gives insights into home background, student and school factors that are associated with the development of the students' skills, many of which provide messages for education policy makers:

- The relationship between socioeconomic background and reading achievement was higher in Australia than in the majority of countries.
- Boys from disadvantaged backgrounds were much more likely than girls to be in the lowest quarter of reading scores.
- Boys were much less engaged in reading than girls and were relatively at a loss in dealing with narrative texts.
- A third of Australia's students said they never read for enjoyment – this percentage was higher in some countries, but the gap in reading achievement between students who never read for enjoyment and those who read for an hour or two a day was greater in Australia than in any other country.
- Higher amounts of homework done were related to achievement in Australia, as in many other countries.
- In Australia, higher teacher morale, a more positive disciplinary climate and greater amounts of support offered by teachers to their students were the most important school factors associated with achievement. The first two of these were at or below the OECD average, but Australia, together with the UK, scored relatively high on the index of teacher support.

Policy messages from the above and other findings presented earlier in the paper are reasonably clear: we need to continue to provide supplementary programs to improve the skills of students who are struggling, particularly Indigenous students and boys, and especially if they are from disadvantaged backgrounds. We need to make school a more attractive place for 15-year-olds and to think of ways we can help students to become more enthusiastic about reading and to engage in it more than they currently do. Teachers and parents need to encourage students to do their homework and school conditions need to be as favourable as possible in terms of teacher morale, discipline standards and teacher support of students. Australia was mostly at the OECD average on these kinds of variables, sometimes above – but there is still room for improvement.

⁴ See the paper by Hughes, Greenwood & Frigo in this volume for further details.

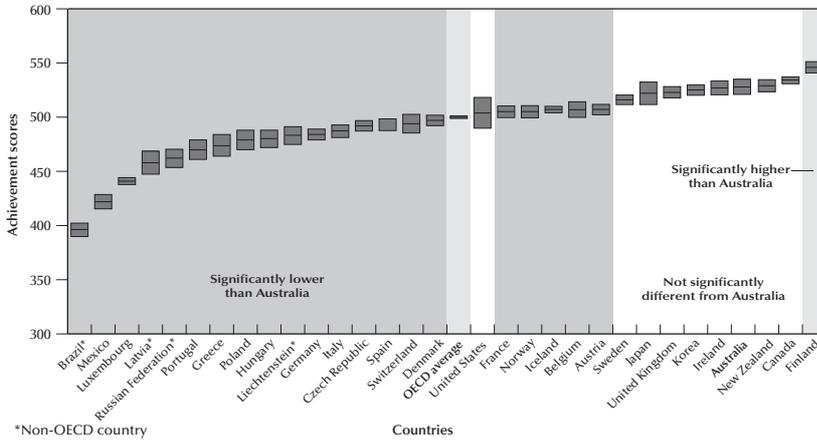


Figure 1: Best Estimates of Reading Literacy Means by Country.

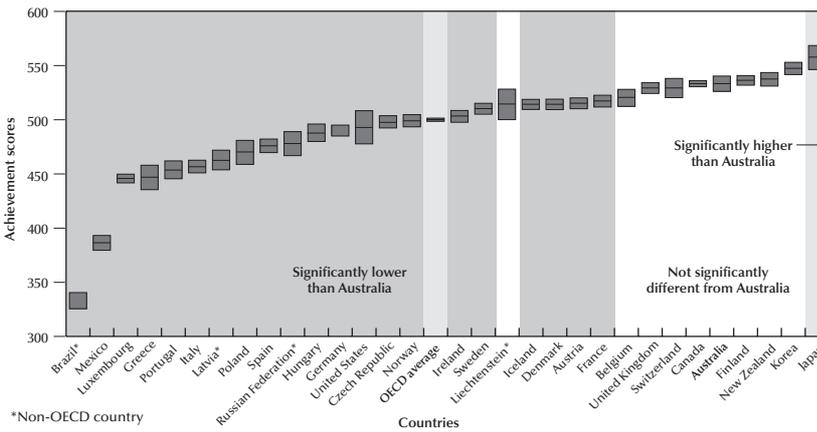


Figure 2: Best Estimates of Mathematical Literacy Means by Country

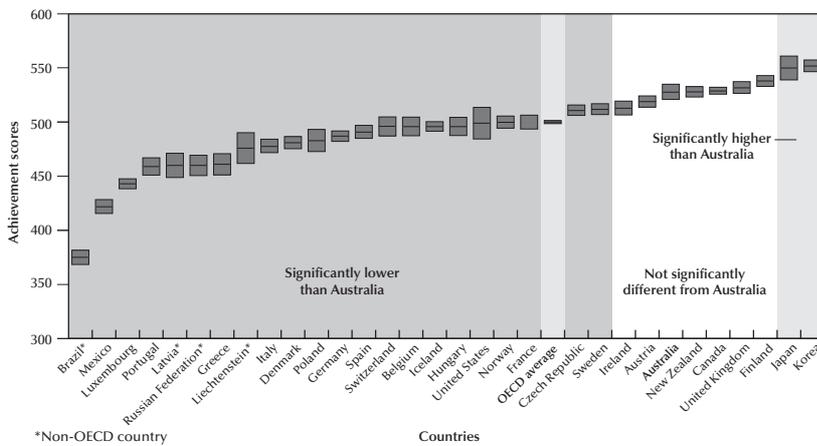


Figure 3: Best Estimates of Scientific Literacy Means by Country

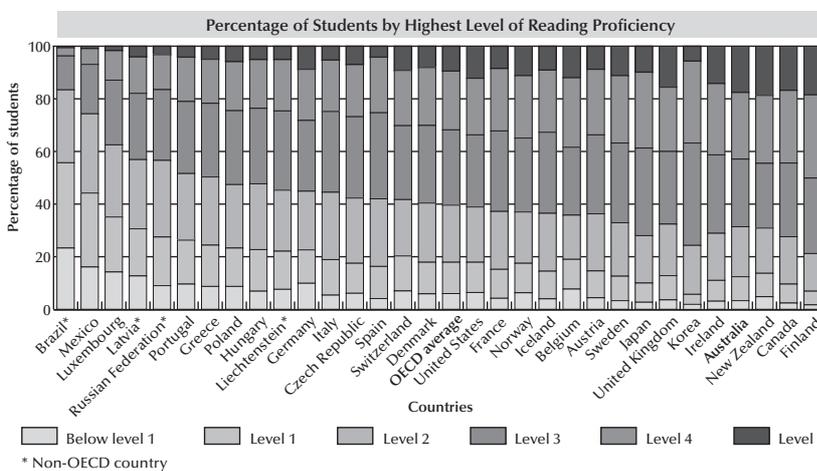


Figure 4: Distribution of Students by Reading Proficiency Level

Retrieving information, interpreting, reflecting, and then... Using the results of PISA reading literacy

Juliette Mendelovits

Juliette Mendelovits is a Senior Research Fellow at the Australian Council for Educational Research. After graduating with a Master of Arts degree in English Literature, Juliette taught at secondary and tertiary institutions before coming to ACER in 1991. Since then she has worked mainly in literacy and humanities areas, developing assessments for primary and secondary school and university level. Within the Measurement Division of ACER she has led a test development team specialising in outcomes-based assessments. She has directed a number of projects including the development of an award winning English assessment for the Education Department of Western Australia's Monitoring Standards in Education program. Since 1998 Juliette has been engaged in work for the reading literacy component of the OECD's Program for International Student Assessment (PISA) project. She played a leading role in the development of the reading literacy instrument for PISA 2000 and is one of the authors of the PISA 2000 thematic report on reading, to be published by the OECD (in press). She is project director for ACER's International Schools' Assessment.

When the initial report on PISA 2000 (OECD 2001) was released in December last year there was hardly a ripple in the Australian press. Jan Lokan, National Project Manager and first author of the Australian PISA report (Lokan et al, 2001)¹ gave a few press conferences and there was an article or two in the national and big-city papers. Immediate public reaction was muted, to say the least. Why should it be anything else? One reason is that Australia did very well in the horse race, in reading literacy coming equal second – along with about seven other countries – surpassed only by Finland. But therein, most likely, lies the reason or at least one of the reasons for the silence – no news is good news.

Contrast this with the furore that has been going on in Germany for the past nine months. Germany performed significantly below the OECD average in all three domains of reading, mathematical and scientific literacy – not the expected result for a nation that prides itself on its 'historically strong education system' (Schmoll, 2002). Maybe I was just lucky, but it seems more than coincidence that on my two brief trips to Europe since last December I should each time, by chance, come across PISA publicity. In early January a newspaper article in the *Frankfurter Allgemeine* (the English version) talked of the cultural rethink necessary for the whole of Germany – not just in education but in family and social life also. Then, in July, I happened to be in Belgium when the Länder – States' – results were released. On late night television, channel surfing, I caught a panel discussion between Andreas Schleicher (the head of PISA at the OECD) and representatives from several States talking about the differentially disappointing results in various parts of the country. One bit I did understand, with my limited German, was a state minister for education's expostulation: 'Yes, that's typically German – the attention is focussed on whether to blame the teachers, or blame the parents but never, "What can we do about this to improve things!"' Another reaction, among Germans I spoke to, was to blame the test: 'How come English-speaking countries did so well?

It's a biased test.' Or to defend the curriculum: 'We Europeans spend so much time learning other languages that we don't have the curriculum time to get our students to acquire the same level of skill in the mother-tongue as monoglot countries.'

There is much to be said about each of these German responses, but my point is mainly to contrast the interest and introspection provoked by PISA in Germany with the silence in Australia – at least the immediate silence. What will, or indeed can, Australia learn from PISA, and how can PISA be used to inform our understanding of and to improve reading literacy?

I want to answer this question with a description of three uses of PISA reading literacy in Australian contexts. The first is a pragmatic use of the PISA results at a national level: *retrieving information* from the international study and using it to define a benchmark for reading literacy for Australian 15-year-olds.

The second is a research-based use of the PISA reading literacy scales: *interpreting* the scales at different levels, downward, to describe reading literacy development on a continuum from Year 3 up to the PISA levels, for 15-year-olds.

The third is *reflecting* on PISA: using what we have learnt about reading literacy to question, evaluate and perhaps modify the way we conceive of, describe and teach reading in Australia.

'Retrieving information', 'interpreting' and 'reflecting' are central terms in the PISA reading literacy lexicon. In the PISA reading framework (OECD, 1999) the construct for the reading assessment instrument was built by defining a number of variables, subdivided into categories. The chief of these variables were 'situation' – the contexts in which people read; 'text format' – the structure of the text; and 'process' – the aspect from which the reader approaches the text. The categories within the last of these – aspects or processes – formed the basis of the reporting scales for reading literacy: retrieving information, interpreting

¹Participating countries were encouraged to release their reports on the same day the OECD released the international report.

and reflecting. Each of the aspects was represented by a specified number of tasks in the main study reading instrument, and proficiency in reading is described as proficiency in Retrieving information, in Interpreting and in Reflecting, along three separate continua.²

My use of the terms 'retrieving information', 'interpreting' and 'reflecting' to identify and differentiate ways of using the PISA reading results is not completely serious: of course, all three processes, or aspects, are at work in all of the suggestions I've outlined. But perhaps it could be argued that one of the aspects is salient in each case. There was a similar degree of arbitrariness (although the effort was pretty serious) in categorising tasks for PISA reading. In most tasks all three aspects play some part, but each task had to be identified for reporting purposes as belonging to the retrieving information, interpreting or reflecting aspect.

- Retrieving information is defined as locating one or more pieces of information in a text.
- Interpreting texts is defined as constructing meaning and drawing inferences from one or more parts of a text.
- Reflecting is defined as relating a text to one's experience, knowledge and ideas.

Each of these three aspects is defined in five levels of proficiency, with Level 1 being the lowest level, and level 5 the highest.

From the outset, PISA rejected the idea of literacy as capacity that is either present or absent: rather it is conceived of as an 'advancing set of knowledge, skills, and strategies, which individuals build on throughout life' (OECD, 1999). The five levels described in the PISA reading scales are an attempt to define this advancing proficiency along different aspects of reading. As a corollary, PISA has not attempted, at an international level, to define what is an 'adequate' level of literacy, or, conversely, to mark a point at which an individual, a group or a nation is 'at risk' because of a particular level of literacy. Nevertheless, in a national context, it is meaningful and arguably essential to define such a point. And so we come to the first of the proposed ways of using the results of PISA reading.

Retrieving information from the PISA reports to define benchmarks for reading literacy for Australian 15-year-olds

MCEETYA has established benchmarks for 'minimum acceptable standards' of reading, writing, spelling and numeracy for Years 3, 5 and 7. It has also, from early on, expressed the intention of setting benchmarks for

an older, mid-secondary level cohort: either Year 9 or Year 10. The decision has now been made by MCEETYA's Performance Measurement and Reporting Taskforce (PMRT) to use the PISA results as the benchmark, reporting on the age cohort of 15-year-olds, rather than a grade level cohort.

The PISA scales offer a neat way of establishing national benchmarks in reading and numeracy (or, as they are called in PISA, reading literacy and mathematical literacy) for this older age group, without repeating in all its detail the process that has been attached to standard setting for the younger cohorts.

How can this be done? The PMRT first needs to decide whether it is going to adopt a benchmark standard similar to that established for the younger cohorts, that is 'minimum acceptable standard'. It would be possible to take a different approach, for example, measuring Australian 15-year-olds' proficiency against the OECD mean. If the former approach were taken, however, the meaning of 'minimum acceptable standard' would need to be modified for the 15-year-old cohort. For Years 3, 5 and 7 the benchmark defines the 'minimum acceptable standard needed to progress satisfactorily through school'. The 15-year-old benchmark definition would need to take account of the different pathways that young adults may follow from 15 years onward, so that 'minimum acceptable standard needed to progress satisfactorily through school' for 15-year-olds could become 'minimum acceptable standard needed for life and learning beyond school'.³

The PISA reading literacy scale has been divided into five described levels of proficiency. A key step in setting the benchmark will be to determine, judgmentally, what point on the PISA scale is considered the minimum acceptable standard. This will be a matter of inspecting the descriptions of the scale and the tasks that are located around the point or points in question. Forty-five tasks from PISA 2000 have been released (OECD, 2002). The tasks span the range of levels, aspects and text formats, and are well suited to this purpose. The question to be asked is, 'Would we expect a student performing at a minimum acceptable standard to be able to perform this task?' Another way to put the question is, 'Would you be worried about a student who couldn't do this task?' – a process similar to that used to define the benchmarks at Years 3, 5 and 7.

Taking the simplest case, the Benchmark Committee could decide, for example, to consider as possible benchmark locations the cutpoints between Level 2 and Level 3; or between Level 1 and Level 2; or between Below Level 1 and Level 1.

²For a detailed description of the development of the described proficiency scales for reading see *PISA 2000 Technical Report* (Adams & Wu, in press), Chapter 16.

³The phrase comes from the program for the PISA Symposium on *Assessing Policy Lessons from PISA 2000* (Berlin, November 2002).

What would these levels look like substantively? Here are the descriptions for the three levels in question:

	Retrieving information	Interpreting	Reflecting
3	Locate, and in some cases recognise, the relationship between pieces of information, each of which may need to meet multiple criteria. Deal with prominent competing information.	Integrate several parts of a text in order to identify a main idea, understand a relationship or construe the meaning of a word or phrase. Compare, contrast or categorise taking many criteria into account. Deal with competing information.	Make connections or comparisons, give explanations or evaluate a feature of text. Demonstrate a detailed understanding of the text in relation to familiar, everyday knowledge, or draw on less common knowledge.
2	Locate one or more pieces of information, each of which may be required to meet multiple criteria. Deal with competing information.	Identify the main idea in a text, understand relationships, form or apply simple categories, or construe meaning within a limited part of the text when the information is not prominent and low-level inferences are required.	Make a comparison or connections between the text and outside knowledge, or explain a feature of the text by drawing on personal experience and attitudes.
1	Locate one or more independent pieces of explicitly stated information, typically meeting a single criterion, with little or no competing information in the text.	Recognise the main theme or author's purpose in a text about a familiar topic, when the required information in the text is prominent.	Make a simple connection between information in the text and common, everyday knowledge.

Figure 1 Extract from Reading Literacy Levels Map⁴

A substantive approach to the issue would involve inspecting the PISA descriptions and the reading tasks around the Level cutpoints and determining whether one would confidently expect students at a minimally acceptable level of reading proficiency to be able to perform such tasks.

However, it would be disingenuous to pretend that decisions about benchmarks are made on substantive grounds alone: what level of 'below minimum standard' can be tolerated will also be considered.

So let's take a look at the percentages we're considering here. In Australia (combined reading literacy scale) the results for PISA 2000 on the combined reading literacy scale were:

Below Level 1:	4%
Level 1:	10%
Level 2:	19%
Level 3:	26%
Level 4:	24%
Level 5:	18%

Would it be tolerable to say that 4 per cent of Australian 15-year-olds (the percentage below Level 1) are below minimum acceptable standard, or at risk? Or would it be tolerable to say this of 14 per cent of 15-year-olds (the percentage below Level 2)? Or 33 per cent (the percentage below Level 3)?

Once the Australian benchmark on the PISA scale has been agreed, the next step is the estimation of the number of students above and below each benchmark in each jurisdiction, and by nominated subgroups. As long as Australia participates in PISA internationally, and as long as we sample beyond the PISA minimum national sampling requirement (as we did in 2000),

these results will be available from the national data collection for PISA every three years.

If states and territories wish to report against such a national benchmark annually, at system level, it would be possible to use the released PISA items to constitute a full reading test, which could be administered to samples of students in each constituency every year. There are more than enough items in the released set, representing a balance of the framework, to afford an annual data collection to ascertain percentages of students above and below benchmark at the system level. There is a question about security, however, since the items are in the public domain. Nevertheless, as long as there is no reporting at the individual level, there is unlikely to be much agitation about taking the test, and therefore the danger of practice effects could be minimal.

If states and territories' requirement is to report on benchmark status by assessing whole populations, and to report at the individual level, as it is for Years 3, 5 and 7, then theoretically every 15-year-old could be administered a PISA-item assessment composed entirely of PISA items. This would not be a good option, however, as the pressure to practise with the released items, once individual reporting is in the offing, would no doubt be irresistible. One solution would be to select a set of PISA items to embed into either a national assessment for 15-year-olds, or a state- or territory-level assessment. Each jurisdiction could select from the pool of 45 items the set that they considered best suited for their population, and build the rest of the assessment around it to reflect their particular version of the English curriculum.

⁴This extract is taken from the full Reading Literacy levels map published in various places including *Knowledge and Skills for Life: First Results from PISA 2000* (OECD, 2001).

Interpreting and extending the PISA reading literacy scales

PISA measures the outcomes of eight to ten years of formal school education. If we are convinced that what PISA measures is worth measuring, then we will want to make sure that what goes on in classrooms during those eight to ten years contributes to strong outcomes on the PISA scales, and we will want to be able to track how things are going well before the end of compulsory schooling.

With such aims in mind, ACER is currently conducting research within an assessment program to develop the PISA scales downwards, so that we will have described proficiency scales in retrieving information, interpreting and reflecting that map student progress from Year 3 onward.

The project in which this work is being conducted is the International Schools' Assessment (ISA), an assessment of Grade 3, 5, 7 and 10 students in reading literacy, mathematical literacy and writing that is using the PISA frameworks for its test construct and will use modified versions of the PISA scales for reporting results. The ISA is being administered for the first time in October 2002. Both the reading literacy and mathematical literacy instruments for the ISA are a combination of tasks from three sources: PISA 2000; the Literacy and Numeracy National Assessment (LANNA), an Australian assessment used by independent schools for reporting benchmarks to the commonwealth; and items developed specifically for the project.

In the case of reading literacy, the items that have been developed and selected at each year level represent, in PISA-specified ratios, two of the three main variables we discussed above – 'aspect' and 'text format'. The mix of multiple choice and constructed response tasks used in PISA reading is also duplicated in the ISA.

By using a substantial number of PISA items in both the Grade 7 and Grade 10 tests, it will be possible to calibrate the new ISA items onto PISA-anchored scales, and from there to define reading proficiency below Level 1 (something we were unable to do with the PISA 15-year-old sample) in terms of the ISA items that populate our downwardly extended scales.

To take an example of how this is being done, let's look at the 'interpreting' scale and at the lowest PISA level of described performance: 'Recognise the main theme or author's purpose in a text about a familiar topic, when the required information in the text is prominent.'

This Level 1 description is simply a summary. In the work that went into describing the scales, four variables were identified that contribute to making an interpreting task more or less difficult: the type of

interpretation (identifying a main idea, understanding a relationship, construing meaning or analogical reasoning); the degree of explicitness of information; the nature and amount of competing information; and the nature of the text.

An example of a Level 1 interpreting item from the PISA released set was based on a magazine article about running shoes and required the reader to recognise the main idea in the article (see Appendix 1).

The main idea was implied in the subheading and repeated several times in the body of the article. In this item, the type of interpretation is the easiest – identifying a main idea. The information is given inexplicitly. There is a little competing information but the repetition of the idea and its prominence (near the beginning of the text) probably compensates for this. Regarding the nature of text, the article is of medium length and has several sections.

An 'interpreting' item from the Grade 3 ISA test was, obviously, less demanding. It asked the reader to identify a main idea in a short text that would be highly familiar to most students: an advertisement for a young children's alphabet cubes game (see Appendix 2).

A very easy task on this text asked students to identify who the game is mainly for: adults, children, teenagers or parents? The information is not given literally but the brevity of the text, the support offered by the illustrations and the very familiar content all combine to make this a particularly easy text to interpret. Finding one of the main ideas – the intended audience of the advertisement – was made relatively easy because there are many hints about the audience: the nature of the game, the children's comments given as testimonials, the ages of the children giving testimonials. There is little distracting information: the word 'family' is used in the text, but it is not one of the alternatives offered in the multiple choice format. Eight-three per cent of Grade 3 students were successful in this task.

By articulating the constituents of each aspect and inspecting the calibrated items, like this one, in the light of those constituents, we will arrive at an empirically based progression of descriptions, with the theoretical framework underpinning it. The lowest 'interpreting' level might, then, look something like: 'Recognise the main theme in a short, simple text about a familiar topic when the required information in the text is prominent and repeated.'

Some preliminary work has been done to map the PISA described proficiency levels onto the Grade 3 to Grade 10 scale using trial test data from international and Australian schools. Figure 2 shows the first pass at this work.

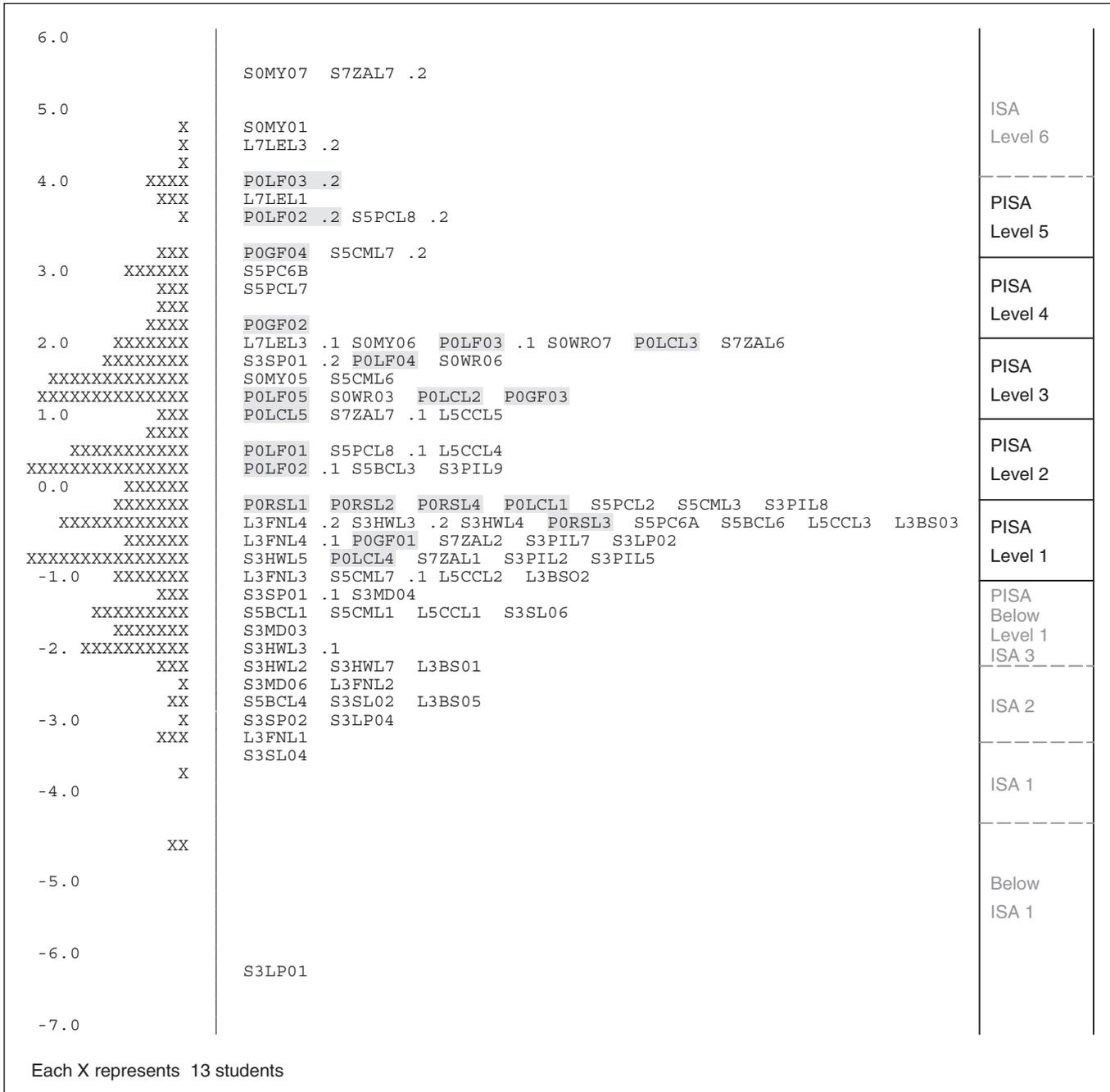


Figure 1 Sketch of extended PISA combined reading literacy scale

The item threshold map is an analysis of trial tested items that are being used in the first administration of the ISA. The items are shown to the right of the axis. Shaded items are those that were selected from the PISA 2000 released reading set and that are being used in the ISA in October 2002. They were also trial tested for the ISA, so we can see their position in relation to the ISA items for Grades 3, 5, 7 and 10. To the far right of the figure is a sketch of where the PISA proficiency levels might sit, based on the PISA items' calibrations. Also sketched are some cutpoints to show where we might place levels below the lowest described PISA level and, possibly, a level above PISA Level 5.

The immediate user group that will get the reports on these scales is international schools. At this early stage of the project's life, schools in around 20 countries, mostly Asia and Europe, are involved. Obviously this group is particularly interested in a reporting framework that is based on PISA's, with its international genesis and international endorsement. Although the assessment is being targetted specifically at international schools, the described scales we are developing should be of significant interest to a much wider audience – we hope, in particular, to Australian audiences.

Reflecting on the PISA framework and Australian results to inform concepts of reading and pedagogical practices

The third use of PISA results proposed here is a less operational and more diffuse one, although its implications are very practical.

Reading literacy as instantiated in PISA insists that to benefit from and contribute to a modern democratic society people need to be able to do a multiplicity of things with different texts, for different purposes.

‘Texts’ means not just prose, but also charts, graphs, diagrams, advertisements and – in the PISA definition, though not yet in its practice – hypertexts. The multiplicity of things that ‘people need to be able to do’ with texts includes not just comprehension (more or less literal understanding of the text), but also interpreting, extrapolating from, comparing and contrasting, applying texts to one’s own experience and knowledge, and conversely applying one’s own accumulated experience and knowledge to texts. For some purposes, retrieving a single piece of information from a text is what is called for; for other purposes, drawing on a value derived from a deep and rich experience of literature may be needed in order to make a sensible judgment about a particular piece of writing.

The third use of PISA proposed here is to look at the different perspectives from which PISA defines and describes reading literacy, and to use those perspectives, and Australia’s results, to reflect on and perhaps modify the way we conceive of and teach reading in Australia.

As one way of approaching this, we can look at Australia’s performance on the Aspect subscales used by PISA. Figure 3 shows Australia’s mean performance on each subscale compared with the performances of the five other predominantly English-speaking countries that took part in PISA 2000. The figures are given on the PISA scale, for which the OECD mean on the combined reading literacy scale was set at 500 and the standard deviation at 100.

As can be seen here, all the English-speaking countries with the exception of the United States performed well above the OECD average on all three aspects. But digging deeper, how can we use these results to inform the way we conceive of and teach reading in Australia?

	Retrieving		Interpreting		Reflecting	
	mean	s.e.	mean	s.e.	mean	s.e.
Australia	536	(3.7)	527	(3.5)	526	(3.5)
Canada	530	(1.7)	532	(1.6)	542	(1.6)
Ireland	524	(3.3)	526	(3.3)	533	(3.1)
New Zealand	535	(2.8)	526	(2.7)	529	(2.9)
United Kingdom	523	(2.5)	514	(2.5)	539	(2.5)
United States	499	(7.4)	505	(7.1)	507	(7.1)
OECD average	498	(0.7)	501	(0.6)	502	(0.7)

Figure 3 Aspect means for English-speaking countries

First, the term ‘teach reading’ bears some reflection. In the early years of school, teachers definitely do, deliberately and explicitly, teach reading. But once students can decode ‘reading’ it is not a separate subject. Instead it is embedded in the learning areas – English, of course, and, ideally, every other learning area for its own purposes. Nevertheless, descriptions of what we mean by reading are not articulated anywhere other than in the English and Languages Other Than English documents. Probably for that reason one of the aspects of reading identified by PISA, ‘retrieving information’, gets a very short run.

Most Australian teachers of English would not have much trouble with the ideas of interpreting and reflecting as being essentials of the readers’ repertoire, and descriptions of processes synonymous with interpreting and reflecting are the staple of the national English frameworks in all their varieties. Retrieving information, on the other hand, is less likely to be recognised as part of the English curriculum beyond the early years of schooling. While Australia performed comparatively well on the ‘retrieving information’ scale, the skills and understandings that are peculiar to retrieving information do not appear in our profiles for reading beyond about Level 4.⁵ It would be worthwhile to have a look at those upper levels of the PISA scale describing retrieving information, and at the clusters of items that appear at the top of the retrieving scale to ensure that the understandings about text structures, and conventions and the skills to negotiate complex texts, figure somewhere in our national and system descriptions of what we mean by ‘reading’ and by ‘progress in reading’.

In contrast to the ‘retrieving information’ scale, Australia performed relatively poorly on the ‘reflecting’ scale in comparison with other predominantly English-speaking countries. This despite the fact that, as I mentioned earlier, most Australian teachers of English would not have much trouble with the notion that reflecting is an essential part of the readers’ repertoire.

Lokan et al (ACER, 2000) report that Australia did comparatively poorly on tasks based on narrative texts compared with tasks based on expository texts. Can we put this together with Australian and other English-speaking countries' performance on the reflecting scale to say something about national concepts of reading and teaching methodologies?

One way of approaching this issue – beyond looking at the mean scores for reflecting – is to inspect the results for different selections of items from the reflecting strand. To do this, two kinds of tasks were grouped together: one group of eight tasks that deal with critical evaluation – either linguistic or stylistic issues, or issues of logical consistency; and another group of eight tasks that ask students to draw on personal opinion or personal experience. The items are from a variety of units based on different text types and formats: narrative, expository and argumentative texts in continuous text (prose) format, and tables and diagrams in non-continuous format. The comparison, shown in Figure 4, again focuses on Australia's performance relative to the performances of other predominantly English-speaking countries.

	Critical evaluation (% correct)	Personal response (% correct)
Australia	44.3	48.2
Canada	48.0	55.8
Ireland	43.2	54.1
New Zealand	44.9	51.1
United Kingdom	50.1	51.1
United States	40.2	45.5
English-speaking average	45.1	51.0
OECD average	38.2	47.6

Figure 4 Performance of English-speaking countries on selected reflecting items

The most striking result here concerns the UK rather than Australia. Great Britain, which has a strongly literary curriculum for English, does well in comparison with the other English-speaking countries on the critical evaluation items, though only performs at the average level (for English-speaking countries) on the personal response group. Canada also performs comparatively well on critical evaluation and exceptionally well on the personal response group. Australia is below the average for English-speaking countries on both types of reflective item, and almost at the OECD average for personal response items.

One hypothesis to draw from this is that a literature-centred syllabus may develop skills of critical evaluation more successfully than does our more thematic and issues-based approach to English. This may not be of concern but we should at least be aware that that's the trade-off we've made. And the results presented here suggest that in the area of reflection and critical evaluation generally, and not only evaluation confined to literary texts, we could learn something from other English-speaking countries' curriculum approaches.

To go back to my question at the beginning of this paper: What will Australia learn from PISA and how can PISA be used to inform our understanding of and improve reading literacy? I believe there will be changes to the way we think about, measure and teach reading literacy in Australia as a result of PISA. The changes are unlikely to make headline news, but they are likely to have subtle and long-term beneficial effects on the development of reading literacy in Australia.

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⁵See in the National Profile for English, for example, Reading and Viewing 4.5 and 4.8b (Curriculum Corporation, 1994). Beyond these outcomes there are no references to skills and knowledge in retrieving information in texts. The lack of description of retrieving information skills in Australia's systemic and national descriptions for Reading in English was drawn to my attention by Jocelyn Cook, Education Department of Western Australia. Her contributions to this and other aspects of this paper are gratefully acknowledged.

FEEL GOOD IN YOUR RUNNERS



For 14 years the Sports Medicine Centre of Lyon (France) has been studying the injuries of young sports players and sports professionals. The study has established that the best course is prevention ... and good shoes.

Knocks, falls, wear and tear...

Eighteen per cent of sports players aged 8 to 12 already have heel injuries. The cartilage of a footballer's ankle does not respond well to shocks, and 25% of professionals have discovered for themselves that it is an especially weak point. The cartilage of the delicate knee joint can also be irreparably damaged and if care is not taken right from childhood (10–12 years of age), this can cause premature osteoarthritis. The hip does not escape damage either and, particularly when tired, players run the risk of fractures as a result of falls or collisions.

According to the study, footballers who have been playing for more than ten years have bony

outgrowths either on the tibia or on the heel. This is what is known as “footballer’s foot”, a deformity caused by shoes with soles and ankle parts that are too flexible.

Protect, support, stabilise, absorb

If a shoe is too rigid, it restricts movement. If it is too flexible, it increases the risk of injuries and sprains. A good sports shoe should meet four criteria:

Firstly, it must *provide exterior protection*: resisting knocks from the ball or another player, coping with unevenness in the ground, and keeping the foot warm and dry even when it is freezing cold and raining.

It must *support the foot*, and in particular the ankle joint, to avoid sprains, swelling and other problems,

which may even affect the knee.

It must also provide players with good *stability* so that they do not slip on a wet ground or skid on a surface that is too dry.

Finally, it must *absorb shocks*, especially those suffered by volleyball and basketball players who are constantly jumping.

Dry feet

To avoid minor but painful conditions such as blisters or even splits or athlete’s foot (fungal infections), the shoe must allow evaporation of perspiration and must prevent outside dampness from getting in. The ideal material for this is leather, which can be water-proofed to prevent the shoe from getting soaked the first time it rains.



KRAZY KUBES

We play every day after school. I can't wait to get home to play.

Joh, age 7

Krazy Kubes are the best!

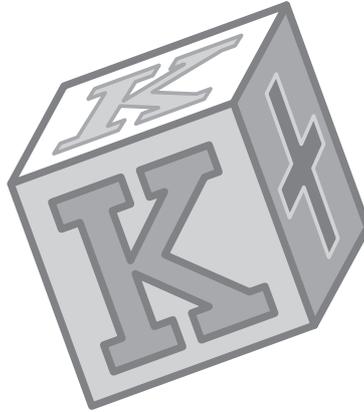
Sally, age 8

Krazy Kubes are a great new game for all the family.



Our teacher lets us play Krazy Kubes and sometimes she even plays too.

Elise, age 9



You can build, you can read, you can add, and most of all, you can have...

FUN FUN FUN!



Laugh and learn with Krazy Kubes

Messages for minority groups in Australia from international studies

Lisa Greenwood, Tracey Frigo and Paul Hughes

Lisa Greenwood is a Research Fellow at the Australian Council for Educational Research. Since joining ACER she has worked primarily on a range of large-scale international studies and smaller statewide assessment programs. Her involvement in international studies includes the Third International Mathematics and Science Study (TIMSS) and the International Association for the Evaluation of Educational Achievement (IEA) Civics Study. More recently she has been working on the national component of the OECD Programme for International Student Assessment (PISA).

Tracey Frigo is a Research Fellow at the Australian Council for Educational Research. She comes from a teaching background and has taught in secondary schools both in Australia and England. Since commencing work as a research officer with ACER, Tracey has worked across a range of projects including large-scale testing programmes, equating studies, nationwide surveys of schools and case studies of effective practice. She was a researcher on a major ACER research project that highlighted teaching practices to enhance English literacy skills in Indigenous primary school students. Tracey has since authored and co-authored a number of reports that focus on improving educational outcomes for Indigenous students in the areas of numeracy development, school VET programs, and assessment and reporting. Currently, she is coordinating ACER's Longitudinal English Literacy and Numeracy Survey for Indigenous Students.

Professor Paul Hughes is Yankunytjatjara/Narungga Aboriginal Australian and is currently the Director of Yunggoorendi First Nations Centre for Higher Education and Research and Chair of the College of Indigenous Education and Research at the University of South Australia. He has a long association with education in South Australia having worked as a primary school teacher, and within government departments and universities. He has chaired numerous state and national Indigenous education bodies including the SA Aboriginal Education Committee, the Aboriginal Education Policy Taskforce, and the MCEETYA Taskforce on Aboriginal Education. He has also worked with the Commonwealth Curriculum Development Centre, the Schools Commission and Schools Council, as well as being a member of the committee that developed an International Charter for Indigenous Education. He is currently a council member of the Australian Council for Educational Research, chairing its Indigenous Education Advisory Committee.

Results from international studies such as the recent OECD Programme for International Student Assessment (PISA) tend to be reported in the media in terms of national averages, with a focus on the ranking of participating countries. However, the disaggregation and analysis of data collected from various social groupings within countries provides an opportunity to investigate the extent to which countries support students from various minority groups to achieve equitable educational outcomes.

In Australia, the gap between educational outcomes for Indigenous¹ and non-Indigenous students at all levels of education has long been a concern (Long et al, 1999). In recent years, Indigenous education policy has placed a high priority on gathering data on educational outcomes as a way of monitoring the extent to which educational equity is being achieved for Indigenous students. While national data collections contain achievement data of students at primary school and in the post-compulsory years, less is known about the achievement and characteristics of 15-year-old Indigenous students. The PISA study provides a unique opportunity to collect data on this group of students and to compare their achievement with non-Indigenous Australian students and students from other countries.

This summary paper provides results on some aspects of the findings from the PISA study, using primarily the data on the sampled Indigenous students. Secondly, it discusses the potential the results have for monitoring the improvement of education for Indigenous students.

Scope of PISA

The OECD Programme for International Student Assessment (PISA) provides a unique opportunity to assess and compare the skills and knowledge of students, in three key areas, as they near the end of their compulsory schooling.

Some of the questions PISA addresses are:

- How well are young adults prepared to meet the challenges of the future?
- Are they able to analyse, reason and communicate their ideas effectively?
- Do they have the capacity to continue learning throughout life?

More than a quarter of a million students from 32 countries participated in the PISA 2000 assessment. The target population was defined as those students aged 15 years and enrolled in an educational institution, either full- or part-time at the time of testing.

In Australia, a total of 5,176 students from 231 schools participated in PISA. One hundred and ninety-two of these students identified themselves as Aboriginal and/or Torres Strait Islander. In addition, a further 301 Indigenous students participated as part of a special national option to oversample this minority group. Six hundred students who were identified as Indigenous on the list of age-eligible students provided by the school, and who were not randomly selected to be part of the main sample, were invited to participate. The

¹In this paper, Indigenous students refers to Australian Aboriginal and Torres Strait Islander students. This is in contrast with the use of the term Indigenous in the international PISA report, which refers to all students born in the country where the assessment took place.

sampled and invited students together include all the Indigenous students aged 15 from the national random sample of schools and, as a consequence, results can be reliably reported for them as a group.

The consultative process

The oversampling of Indigenous students was a recommendation from the PISA National Advisory Committee. This group also suggested the formation of an Indigenous Education Consultative Group, whose main role included the assessment of items from both the assessment booklet and student questionnaire for their relevance to the Indigenous student.

ACER strongly supported this suggestion: research on Indigenous education issues at ACER is informed by its own Indigenous Education Advisory Committee and by Indigenous education policy documents and reports that encourage Indigenous participation in the evaluation of education services and Indigenous ownership of Indigenous research. Accordingly, a consultative group was formed and consisted of Indigenous representatives from each state and territory who met with researchers from ACER to discuss the assessment materials and the types of data analyses that would benefit Indigenous students and their communities.

The consultative group was particularly keen to identify individual and school factors associated with success for Indigenous secondary school students. In the past, research has focussed on factors that mitigate against success for Indigenous students including low

literacy achievement, socio-economic status, high levels of absenteeism and remoteness. Less is known about the factors that enable and support Indigenous students to stay at school and succeed.

After much discussion, recommendations were made, including minor adaptations to terminology and vocabulary to the items in the assessment booklets to avoid Indigenous students being confronted with unfamiliar vocabulary and the inclusion of additional items in the student questionnaire. These included Indigenous status, amount of time spent on a variety of out-of-school activities, travel time to school, periods of absence from school in the previous three years and students' educational aspirations.

Results

Some of the findings that have emerged from a preliminary analysis of the data relating to reading achievement and selected student background variables are presented below. There are still many data to be analysed and further results will be given in the conference presentation.

Reading achievement

The relative standings of the 32 participating countries serve as important indicators to monitor key learning objectives and to acknowledge the strengths and weaknesses of their own country's educational system. Australia's results were favourable in comparison to

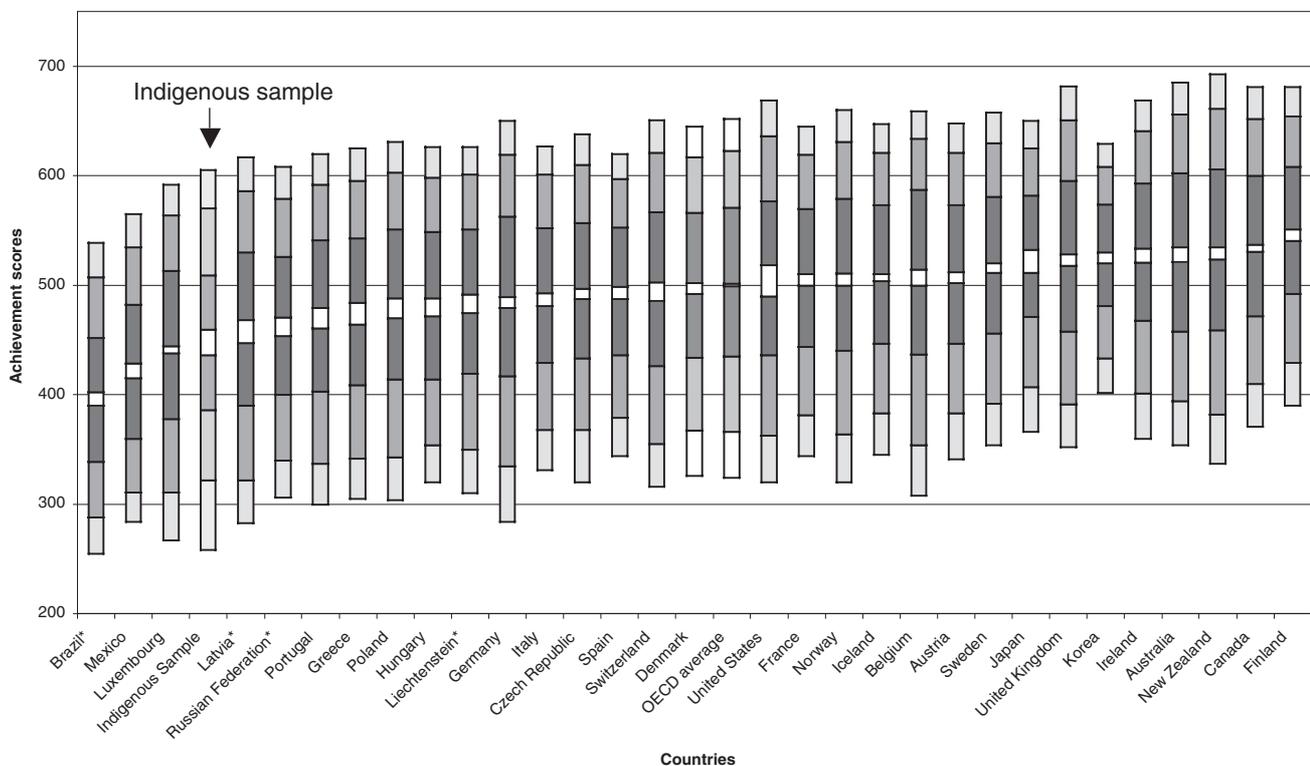


Figure 1 Student achievement on the Reading Literacy Scale by country and including the Indigenous sample

the other countries, achieving significantly higher than the international means in each of the three domains (reading literacy, mathematical literacy and scientific literacy).

In Figure 1, the Indigenous sample has been treated as a 'separate country' and their mean score and distribution of results plotted on the same chart as for all other participating countries. The mean reading literacy score for the Indigenous sample was 448 (compared to a mean reading literacy score of 528 for Australia.) Figure 1 shows that, on average, the Indigenous sample achieved significantly below the international mean and is positioned between Latvia and Luxembourg. It should be noted that there is a range of achievement by Indigenous students. Indigenous students achieved at all proficiency levels for reading literacy, including at the highest level.

When interpreting this data, however, it should also be noted that the Indigenous students who participated in PISA may not necessarily be representative of their age peers. By the age of 15, around 20 per cent of Indigenous students have already left school. Also, 41 very remote mainland schools were excluded from the PISA study and no island schools were included. Finally, of the 600 Indigenous students who were eligible to participate PISA, around 50 per cent participated.

Student characteristics

In addition to completing an assessment booklet, students were asked to complete a student questionnaire. Detailed information about the students' home backgrounds, including parents' occupations, out-of-school activities, attitudes and habits to reading, aspirations for the future and assessment of self-regulated learning were obtained.

The contextual data collected in the student questionnaire provides valuable information in helping to understand the achievement results. It may also provide evidence regarding the factors contributing to student success. Case study research which focuses on successful Indigenous students notes that they have a positive self-concept as learners, are comfortable with their Aboriginality, expect and are determined to succeed and find encouragement and support from significant others in their lives (Russell, 1999; Mecurio & Clayton, 2001).

Socio-economic status

The data collected on parents' occupations was used to create an index of socio-economic status (SES), and was found to be one of the most important student background variables in relation to achievement in Australia. Figure 2 shows the social gradient for SES in reading literacy for several countries, and also for the

Indigenous sample. The social gradient is able to provide information about how well a country has achieved on the reading assessment, how strongly students' results are related to SES and the range of SES for a country.

Generally, the relationship shows that students with lower levels of SES are more likely to have a lower achievement level. Likewise, students with higher levels of SES are more likely to have a higher achievement level.

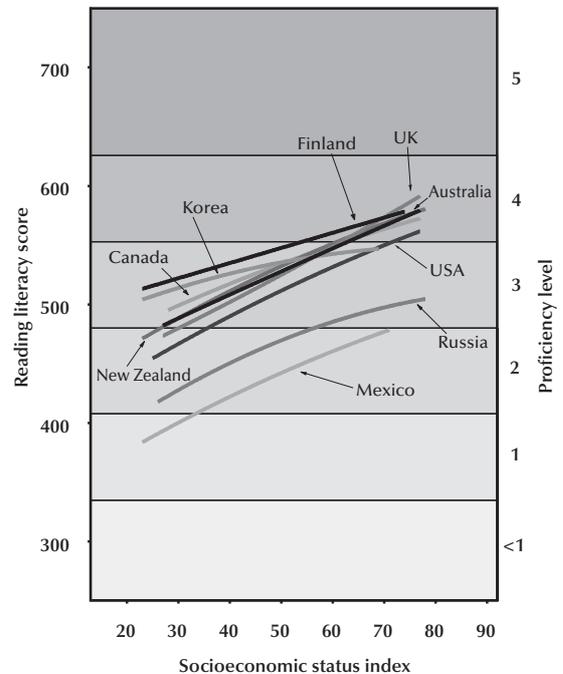


Figure 2 Relationship between reading achievement and SES for several countries and the Indigenous sample

The figure shows the Indigenous sample has a smaller range of SES compared to the whole Australian sample. There is also a notable difference towards the end of the social gradient between the whole sample and the Indigenous sample. In the case of the whole sample, students with a high SES were also those students who were more likely to achieve higher. For the Indigenous sample, however, the social gradient shows there is less SES effect, ie those students from a high SES are not necessarily more likely to achieve higher. A flatter SES gradient is only of concern if achievement levels are relatively low, as in the case of the Australian Indigenous group. On its own, a flatter SES gradient indicates greater equity of outcomes in relation to background. The challenge is to raise the overall level rather than just the top end (see, for example, Korea, which shows relatively high achievement as well as relatively high equity in comparison with other countries).

The example above suggests there may be other factors operating in relation to achievement for the Indigenous students, more strongly than for the Australian sample as a whole where SES is a dominant factor.

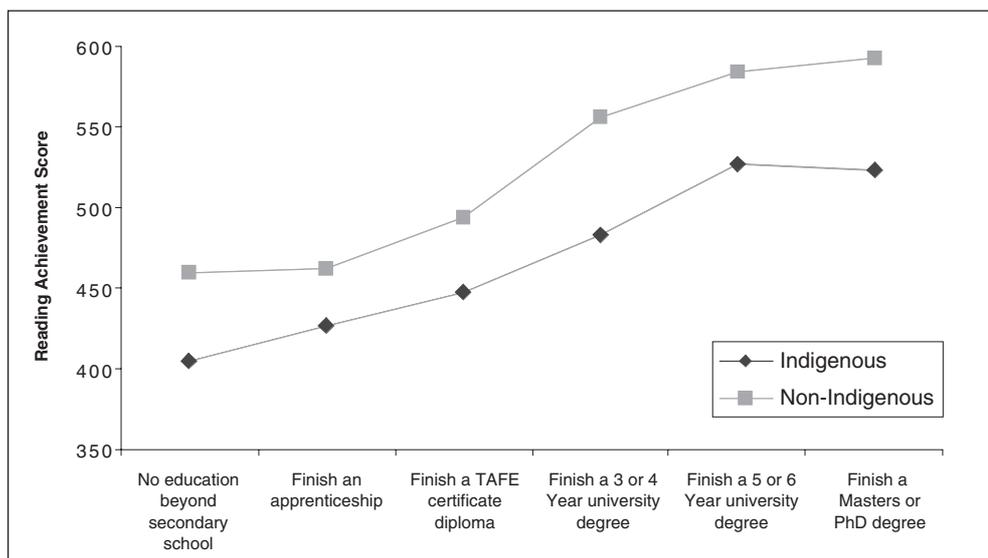


Figure 3 Reading achievement and educational aspirations beyond secondary school for the Indigenous and non-Indigenous sample

Aspirations and attendance

Review papers and research studies consistently state that Indigenous students and their parents have high aspirations and place a high priority on education. The student questionnaire asked students about their educational aspirations beyond secondary school. The findings show students who intended to strive higher educationally were more likely to have a higher reading achievement (Figure 3).

A tenth of the Indigenous students planned not to undertake any education after completing secondary school. A quarter of students expected to finish an apprenticeship and a further quarter indicated they would complete a TAFE certificate or diploma. For those students indicating they planned to attend university, of which almost a quarter indicated they would finish a three or four-year degree, a tenth would complete a five or six-year degree and only a small percentage intended to complete a Masters or a PhD degree (see Table 1).

Educational aspirations	Indigenous students (%)	Non-Indigenous students (%)
No education beyond school	11.9	6.3
Finish an apprenticeship	24.9	12.1
Finish a TAFE certificate or diploma	26.1	20.0
Finish a 3 or 4-year university degree	23.2	37.3
Finish a 5 or 6-year university degree	9.7	18.5
Finish a Masters or PhD degree	4.4	5.8

Table 1 Educational aspirations beyond secondary school

Two of the factors which may be expected to reveal significant differences between the Indigenous and non-Indigenous samples are absenteeism and travel time to school. Interestingly, there was no significant difference between Indigenous and non-Indigenous students in self-reported absences from school over the past three years and travelling time to school was slightly less for the Indigenous students (see Table 2).

Absence from school	Non-Indigenous students (%)	Indigenous students (%)
A few days, if any	47.7	42.6
One or two weeks	39.3	39.8
Three weeks to a month	8.4	10.6
Half a term	2.4	4.3
More than half a term	2.3	2.6

Travelling time to school	Non-Indigenous students (%)	Indigenous students (%)
Less than 15 mins	47.2	56.5
15–30 mins	27.5	24.8
30–60 mins	18	15.7
More than 60 mins	7.4	3.0

Table 2 Absenteeism and travel time to school

It may be that the performance of the Indigenous students is more specifically related to other aspects of their experience as Indigenous students in western education systems. Further exploration of the data will include an analysis of the test items and other individual and school characteristics and will be discussed in the presentation.

Conclusion

The lower average performance of the Indigenous students raises important questions relating to the degree of knowledge and the effective skills these young adults possess in order to meet the challenges of the future.

The fact that the preliminary analysis of the data reveals some unexpected results in the differences in student characteristics between the Indigenous and non-Indigenous students in this study poses some interesting questions about the significantly lower reading literacy levels of the Indigenous students. The main aim of future data analysis will be to examine more closely the individual and school characteristics related to higher achievement by Indigenous students.

The ongoing nature of the PISA study also provides an opportunity to collect data at two further points over next six years from students who will have experienced a range of strategic intervention programs implemented by state and territory education departments and through funding from the Commonwealth's Strategic Initiatives program. These programs aim to improve education for Indigenous students and support them to achieve educational outcomes equal to non-Indigenous students. The closing of the gap between the achievement of Indigenous and non-Indigenous students in future testing provides one measure of the attainment of educational equity.

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PISA Science: pointing the way forward for school science

Peter Fensham

Peter Fensham is Emeritus Professor of Science Education at Monash University. He was a member of the Science Advisory Committee for the Third International Mathematics and Science Study and is a member of the Science Functional Expert Group of the PISA project. He has a long history of research in science education and in 1999 was awarded the Distinguished Researcher Award from the National Association for Research in Science Teaching in the United States. He is well known for his advocacy and exploration of what Science for All means. This is a particular example of his wider interest in inequality and disadvantage in education, about which his 1969 edited book *Rights and Inequalities in Education* helped to set benchmarks for making schooling more equitable. In *Developments and Dilemmas in Science Education* (Falmer, 1988) he extended the theme into science education and drew attention to its international character as a field of research.

The PISA project, coming so soon after TIMSS, was not constrained to follow the comparative curriculum pattern of the IEA study. The proposal, that the project should focus on providing the education systems of the participating countries with information about how well their school systems were preparing 15-year-olds in reading, mathematics and science for contemporary adult life, was welcomed.

The Science Functional Expert Group (SFEG) of PISA was, however, constrained by the reality that science had only a minor place in the first two testings. SFEG had to choose a limited aspect of science and future citizens' lives as the priority for its testing in 2000. The aspect chosen was the impact of reports on science that appear regularly in the media. Consequently, the science abilities to be tested in 2000 (and 2003) would be scientific literacies that enable sense and meaning to be made of such media reports.

An appreciation of the science framework developed for these PISA testings (OECD, 2000) is important for understanding the implications this project has for Australian science education. In the larger testing opportunity of 2006, other important aspects of the science life of citizens may be included, and for these a wider definition of scientific literacy and framework will be needed.

Compared to the general and abstract debates among science experts in the 1990s about what scientific literacy could and should mean, the definition in the PISA Framework is derived from five specific scientific literacies or processes students need in order to read, with meaning, media stories involving science. They need to:

1. recognise scientifically investigable questions;
2. identify evidence needed in a scientific investigation;
3. draw or evaluate conclusions;
4. communicate valid conclusions; and
5. demonstrate understanding of science concepts by applying them in novel situations.

In a retrospective review of the rationale and nature of the PISA Science Framework, Harlen (2001) emphasised that in using each of these five processes, scientific knowledge is involved and so the processes

themselves are intimately part of what the framework regards as science content.

Aims for school science

When the intention to test these scientific processes was first announced there was concern that the project would simply demonstrate that nowhere could 15-year-olds do these things. It was argued that 15-year-olds were too immature to do them or that they would not be able to do them because they had not learnt them in their school science.

Implication 1: The encouraging success of the students in PISA Science provides strong grounds for arguing that the acquisition of this set of scientific literacies should become a priority aim of Australian science education.

Towards the end of this paper I shall indicate some of the other scientific literacies that should also be considered for priority.

Curriculum structure

Since 1990 a number of countries, including Australia, have introduced major curriculum reforms that give science a definite priority of place in the education of students throughout their 10 or more years of compulsory schooling. The content listed for learning in most of these 1990s curricula is, in practice, very similar. It was thus arresting to read in the significant British report, *Beyond 2000*, that the 'changing curricular position of science has not been accompanied by corresponding change in the content of the science curriculum' (Millar & Osborne, 1998).

Elsewhere (Fensham, 2002), I have addressed the reasons for this strange outcome of such large reforms, but a new approach has now emerged in a few countries that is establishing new and more appropriate content. This approach is to separate in the structure of the school curriculum the teaching of science for citizenship from the teaching of science more generally.

Israel and The Netherlands were the first two countries to address the competition and confusion that arises in the teaching of science to two different

school populations – possible future science-based professionals and future citizens. Israel split the two groups after the ninth year of schooling and thereafter provided different science studies for them. The Netherlands went a step further, introducing a mandatory subject, ‘Public Understanding of Science’, for both groups of students in Year 11. In addition, the science group undertakes additional science disciplinary studies.

Similarly, in England and Wales there is to be a new structure in Years 10 and 11 with a core, mandatory subject of the ‘Science for Citizenship’ type, with optional additional science studies.

Implication 2: The successful embrace of PISA Science’s emphasis on science for citizenship by so many Australian 15-year-olds suggests that Year 10 in Australia should be considered as the location for a structural reorganisation of the science curriculum.

A move of this type is certainly needed in Australia if we are to move beyond the present impasse of the intentions for school science in the compulsory years not being matched by appropriate content for learning. Quality teaching of a new science subject in Year 10 may, oddly enough, provide the renewal of interest in science that will increase the numbers of students choosing to take further science studies in Years 11 and 12.

Content

The PISA Science Framework used three major thematic areas to embed its five scientific processes: science in earth and environment, science in life and health, and science in technology. These themes are common ways in which science has relevance to the lives of citizens, and they get regular reportage in the media. Within these themes, PISA Science identified eight topic areas of application that are readily recognisable by science teachers as familiar features of the school curriculum. However, PISA’s intention for these topics is different from how they are usually taught and learnt in school science. In the units and items of the PISA Science test, the concern is with the students’ abilities to *apply* their knowledge of this content in *novel contexts or situations*, that is, to the *transfer of science learning*.

Implication 3: Socially relevant science themes should be considered as replacements for the essentially disciplinary strands in Australian science curricula for the compulsory years, and within these themes a limited number of major scientific ideas and processes should be defined for learning in compulsory schooling.

Pedagogy

Over the last 20 years, Australian science educators – researchers and teachers – have played a leading role

in the development of new pedagogical strategies for school science. However, almost all this rich pedagogical research and practice has been concerned with more effective strategies for learning the conceptual emphasis that has marked the science curriculum for so long.

Australian researchers have yet to embark on research into the pedagogical strategies that will promote the learning of the content/process combinations that have been the foci of PISA Science. Interest in researchers and teachers in collaboratively developing such epistemic processes of science in science classrooms has, however, probably been the most striking new frontier, internationally, in the field during the last decade.

The lack of encouragement for the five PISA processes in the curricula of Australian school science does not make it easy for researchers to engage teachers in collaborative research studies of these scientific processes.

Implication 4: Nevertheless, the PISA results suggest such studies would be rewarding and a start is needed if we are to keep pace with the explorations of these pedagogies that are now actively underway in, for example, Britain, USA, Canada and Norway.

Interest in science

A recurring concern in Australian science education has been the low interest that many students in secondary schooling have for science. The decision by the PISA Science group to use real-life science stories from the media as the context for its sets of items introduced a motivational aspect that had been overlooked, even though the popular media are well versed in such motivational aspects. The early discovery of the story of *Jessica and Her Chocolate Diet* as a possibility for a set of items helped the Science Group have faith that a good story would engage students.

Implication 5: The students’ response to the 2000 testing bore out this faith and suggests that those responsible for Australian science education should revisit the excellent work begun by the Curriculum Corporation in the 1990s to treat the science curriculum as ‘Story’.

This initiative has languished in the Australian states since then, even though it has become mainstream in early childhood education in New Zealand and in Salters’ A-Level Chemistry in England and Wales – the highest level of post-compulsory schooling.

Assessment of science learning

The PISA Science test had three novel features compared with usual science testing, including TIMSS. It used *authentic science stories* as the *contextual units* for its *clusters of items*. This led to testing that provided not

only a more complete and reliable understanding of the students' scientific literacy than the usual isolated items, but also diagnostic information about that knowledge.

Implication 6: The distinctive features in the PISA testing should be retained and strengthened in the current national project to develop tests for use in Australian schools and classrooms.

SES and science learning

In the PISA study, two findings about student background factors and scientific literacy stand out. The first is the absence of a difference between the sexes and the second is the strong effect of a family's socio-economic status (SES). This discrepancy is a matter of concern if one has a sense of equity in relation to the role of the education system as a whole. It is probably what one expects as the education system has increasingly been encouraged to take on a competitive culture. In either stance, it is of interest to ask:

Implication 7: Is the inequity in schooling associated with SES and science learning worsening? With the national interest in science and technology in mind, does the effect of SES matter?

Beyond PISA Science 2000

Although PISA Science in 2000 has a number of interesting implications for the short- to medium-term agenda of science education in Australia, it must not be thought that these are the only issues that Australian science education needs to consider. The PISA project has not yet considered what other aspects of science for citizenship it will include in 2006. Accordingly, in this final section I will draw on my knowledge of international research and of recent developments overseas to suggest some other directions for urgent consideration.

Affective responses to the natural world

The authors of *Beyond 2000* give as the rationale for the study of science by all students at school that it 'sustain and develop the curiosity of young people about the natural world; and foster a sense of wonder, enthusiasm and interest in science so that they feel confident and competent to engage with scientific and technical matters'.

This statement emphasises affective responses to the natural world and to science as humanity's means of exploring that world beyond a general interest in science. The encouragement and development of these responses are largely ignored in the science curricula in Australia, as they are in most countries. Science as intrigue and as

wonder are regularly presented in the public media and these aspects of science are central themes in best-selling books by Australian science writers like Paul Davies, Charles Birch and Margaret Wertheim. There is also evidence now that the national interest in science is suffering through neglect of these responses.

Implication 8: Australian science education needs to consider how to embody these specifically scientific affective responses into its curricula and teaching.

Accessing scientific information

An emerging need from a number of studies of citizens and science is the ability to access trustworthy scientific information. School science has not placed much emphasis hitherto on developing these abilities, even though the existence of the Internet underlines its urgency.

Implication 9: The literacies of accessing scientific information and assessing its trustworthiness should be considered for priority in school science.

Science and technology

One of the great mistakes of the 1990s was the structural division in the curriculum that was created in many countries between science and technology. This structural separation encouraged the interpretation of scientific literacy as being the literacy of the pure scientist, when it was meant to be the science for all students as future citizens. Very often, science is manifested in society in the form of technologies, and it is through technologies, and societal regulations associated with many of them, that citizens commonly become involved with science. The framework for PISA Science recognised this relationship with its major theme science in technology.

Implication 10: The relations between science and technology and their implications for the science curriculum need to be urgently reviewed in the light of the emerging picture of how science and technology impinge on citizens' lives.

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The meaning of PISA for teachers of mathematics

Jan de Lange

Jan de Lange is Chairman/Director of the Freudenthal Institute and a full professor at the University of Utrecht in the Netherlands. His research focuses on modelling and applications and assessment issues and has broadened to multimedia and on issues related to implementation. He served as chairman of several Commissions for the Development of a New Curricula in The Netherlands, and serves as supervisor to curriculum projects in the United States, Bolivia and South Africa. In the international comparative assessment area he has been a member of the National Advisory Board for TIMSS, a member of the international commission for TIMSS-R, and is presently Chairman of the Mathematical Functional Expert Group of the OECD PISA project. As Chairman of this group he had a considerable influence on the writing process of the OECD framework for mathematics. The framework is already considered very influential, as more than 30 countries have adapted it. Jan de Lange has presented lectures in more than 30 countries and has written more than 200 publications, and many of the keynote lectures, presentations and invitations are considered rather prestigious. The students that are presently completing their PhD under his supervision undertake studies in algebra, technology, minorities and mathematics, assessment, design and implementation.

PISA

PISA stands for Programme for International Student Assessment. It is a collaborative effort among the member countries of the OECD to measure how well young adults, at age 15, are prepared to meet the challenges of today's knowledge societies. As such, it is the most comprehensive and rigorous international effort to date to assess student performance and to collect data on the student, family and institutional factors that can help explain the differences in performance.

The assessment is informed – but not constrained – by the common denominator of national curricula. PISA does assess students' knowledge, but it also examines their ability to reflect on the knowledge and experience, and to apply that knowledge and experience to real world issues.

PISA is being implemented on a three-year cycle that began in 2000. Each PISA assessment cycle focuses on one particular subject, although all three are assessed in each cycle. In the first cycle, PISA 2000, reading literacy was the major focus. In 2003, PISA will focus on mathematics literacy. This means that roughly two thirds of the assessment time will be taken by mathematics. In 2006, science will be the main subject. For the remainder of this article I will use mathematics as an example.

Concept

As mentioned before, PISA intends to measure reading literacy, mathematics literacy and science literacy. For mathematics, literacy is defined as follows:

Mathematics literacy is an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments, and to engage in mathematics in ways that meet the needs of that individual's current and future life as a constructive, concerned and reflective citizen.

In order to transform this definition into an assessment of mathematics literacy, three broad dimensions were identified for use in PISA 2000:

- *The content of mathematics.* Mathematical concepts, structures and ideas have been invented as tools to organise phenomena in the natural, social and mental worlds. In the real world, the phenomena that lend themselves to mathematical treatment do not come organised as they are in school curriculum structures. Rarely do real-life problems arise in ways and contexts that allow their understanding and solutions to be achieved through an application of knowledge from a single content strand. If we look at mathematics as a science that helps us solve real problems, it makes sense to use a phenomenological approach to describe mathematical concepts, structures and ideas. The OECD PISA mathematics expert group has adapted these, creating four phenomenological categories to describe what constitutes mathematics: *quantity, space and shape, change and relationships and uncertainty.*
- *The competencies needed in mathematics.* Questions in PISA are structured around different competencies needed for mathematics. These competencies are clustered: the first cluster – *reproduction* – consists of simple definitions, reproduction and recall of definitions, and straightforward problems. The second cluster – *connections* – calls for connection of different aspect of mathematics in order to solve real world problems. The third cluster – *reflection* – calls for more complex problem solving competencies, reflection, generalisation and mathematical thinking.
- *The contexts used in mathematics.* Mathematical literacy is assessed by giving students 'authentic' tasks, based on situations that, while sometimes fictional, represent the kinds of problem encountered in real life.

Results

Before listing possible outcomes for the PISA study, it should be mentioned what kind of test formats will be used. Mathematics literacy will be assessed through a combination of question types. There are a number of units, each representing a situation or problem on

which students are set several questions or tasks (items). Different combinations of diagrams and written information introduce each unit. About two thirds of the items can be marked objectively (multiple choice or open questions). The remainder of the questions (constructed response, open questions) will be assessed by more than one marker.

PISA intends to provide a broad assessment of comparative learning outcomes towards the end of compulsory schooling, which can both guide policy decisions and resource allocations, and provide insight into the factors that contribute to the development of knowledge and skills, and the extent to which these factors are common to different countries. It seeks also to compare how well different school systems prepare students for life in the real world.

The information from PISA allows policy makers to identify and compare the relationships of individual, home and school characteristics with students' performance, and thus allows countries to look at their own education system in the light of other countries performance.

Finally, the ongoing PISA cycle will allow countries to monitor changes in performance over time. This concludes our introduction on PISA.

PISA for teaching practice

Concept

The theoretical framework for mathematics assessment for PISA shows three clear components: content, competencies and context. On each of these dimensions the framework offers some innovative aspects that can be of immediate relevance for teachers. As the German PISA report mentioned, 'the strength of the PISA study lies in the very different conceptualisation of mathematical competences' and in the fact that we have learned more of the role of personal background variables. The report also proposes action along the following lines:

- Development of more real world problem solving tasks;
- A new way of teaching and learning (different classroom culture);
- More teacher professionalisation and more teacher cooperation.

These recommendations are strictly true for Germany and in no way can similar recommendations be found in the official PISA report. But it shows an interesting example of how a country tries to optimise the results from the study and how this can lead to very practice-oriented recommendations. It needs to be emphasised that Germany is a country where the PISA results were considered as a blow to the German educational

system and really lead to a new national effort to improve and change education. This is in strong contrast to the way the study was received in other countries without visible public effect, like in the United States. There the summary of the report for seems to say there is no news worth reporting. Germany and the United States scored the same on the PISA Mathematical Literacy scale.

At this moment, major nationwide activities abound in Germany targeting teachers in the first place. High priority is given to real world problems as these were missing from the German curricula. But maybe more important – because it goes to the very heart of mathematics – is the attention to the different competencies, as clustered in the three categories: reproduction, connections and reflection. As the German report stresses: the different cognitive demands that are described in the PISA competency clusters make it necessary to look differently at our item construction and instruction.

This forms the heart of an approach to changing classroom instruction as is taking shape in a project carried out in the United States.

The last decade has been marked by an incredible amount of change taking place in mathematics education, although not all necessarily in the same direction. PISA can be a powerful instrument in facilitating and guiding or reinforcing new changes.

The sum of all these reforms has not amounted to an effective policy because too often something has been missing: direct help for the teacher to manage complicated and demanding situations, channelling the personal, emotional and social pressures of a group of 30 or more youngsters in order to help them learn and make them even better learners. Teachers need to know about their students' learning, about their progress, about the level of formality, about the processes that form part of problem-solving activities. This process is called 'formative classroom assessment'.

Innovation in mathematics education is often portioned in many different dimensions – new curricular materials, new tests, new tools. The simplistic assumption is that new classroom materials will lead to better learning (in a new classroom culture) and to improved results. In particular, one of the problems is that teachers are often not aware of the need to reconsider their current assessment practices in light of the rich evidence generated when students solve complex, real world mathematics problems.

The instructional intervention that forms the heart of the project we would like to discuss, is the development of teachers' formative assessment practices with a theoretical framework, like the PISA framework, in mind. There is evidence that one key to

change is getting teachers to shift their assessment practices towards assessing for understanding. When teachers learn more about classroom assessment in relation to competencies and learning trajectories, they are better prepared to make instructional decisions based on students' thinking.

Teachers working within the project were confronted with the shortcomings of their own classroom assessment practices. They never required competencies from the connection and reflection clusters and thus restricted the students to mere learning by reproduction.

Teachers all evaluated the use of competency clusters as very beneficial, not only for their assessment practices but also for their instruction and evaluating students' understanding. As teachers explained: 'I really got the opportunity to re-examine myself looking at the items in relation to the competency clusters'. Or: 'The clusters are just: short, sweet and simple'. Or: 'The whole idea of competency clusters took me to another level'. And on the connection between assessment and instruction: 'I have tried to implement the philosophy involving the competency clusters in questioning techniques, informal assessment, class discussions'. Or: 'I am looking at assessment totally differently now than I did four months ago. Prior to involvement in the project I didn't give much thought to assessment until I was ready to test the kids. But now I have asked myself what do I really want them to learn, what do I want them to pick up out of this?'

The concept of competency clusters, in combination with the content and context dimensions, gives teachers the possibility to reflect and innovate their educational practices in a very fundamental and effective way. PISA is not just an international comparative data study for policy level information, but also a powerful tool for innovation at teachers' level.

Results

The most visible outcome in the popular press, and in politics as well, is the place in the rankings-list of all countries. This is remarkable as those rankings have very limited meaning. One can definitely not conclude that one country is 'better' than another country, and identical scores may conceal very different realities. Furthermore, questionnaires may suffer from ambiguous questions or neglect local cultural settings. Results may be treated with a sophisticated methodology that may hide the uncertainty of outcomes.

It is not uncommon that interpreters of reports like TIMSS and PISA point to the teachers as a weak factor in the whole educational system. As *Pursuing*

Excellence stated: 'US teachers' typical goal is to teach students how to do something and do not require students to engage in high-level mathematical thought.' Of course this by itself is not very helpful to teachers.

It may be helpful for teachers to know that much of the outcome of the learning/teaching process is almost beyond their control. But they need to know anyway, so that they know which problem they are to overcome. And also that, in many cases, they can help students achieve better results against the odds.

In 2001 and 2002, many public schools in the Philadelphia school district were privatised because of scores on standardised tests. One should reflect on this process in the knowledge that students attending Philadelphia public schools come from poor families. What is one of the outcomes from PISA? The relationship between wealth and performance in PISA is generally positive. On average, students in OECD countries in the top quarter of the wealth index score about 34 points higher than students in the bottom quarter.

The United States shows the largest difference, the gap in performance between students in the top and bottom quarters of wealth being 85 points. This means that students in the US are at least twice as likely to be among the 25 per cent lowest performers in literacy if they are in the bottom quarter of the PISA index of wealth as if they are in the top quarter.

This information is even more relevant as one sees in the report also that relative lack of wealth is no barrier for excellent scores (Japan, Finland, the Netherlands).

Teachers should know; school boards and policymakers should act.

Reflection

PISA is a highly interesting project with promises and perils. The concept may attract many positive reactions, but some countries do judge it to be rather innovative. The full potential of the framework can only be harvested if the OECD PISA teams allow for a better variety of formats, as is pointed out frequently by evaluators.

The biggest risks inherent with studies like this one is that the data are analysed disconnected from their true meaning. But it offers the participating countries a reference point that is interesting at least with a collection of items that is generally being judged to be equally comparable in each country. But a point that is often forgotten is that these studies can have a lasting impact on the people who really do the education – the teachers and students.

Some publications

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Why do education systems differ in educational outcomes?

John P Keeves

John P Keeves is a professorial fellow in the Flinders University Institute of International Education and was formerly the Director of ACER. After teaching mathematics and science for 14 years in secondary schools in South Australia and the United Kingdom he received training in educational research at ACER and the University of Melbourne. He has been actively involved in IEA studies for nearly 40 years, is a Fellow of the Academy of the Social Sciences in Australia and holds doctorates from the Australian National University and the University of Stockholm.

The focus of this conference is 'What can Australia learn from international achievement studies?' In order to address this question it is necessary to examine developments in the field of comparative research in education and the findings produced by The International Association for the Evaluation of Educational Achievement (IEA) and related studies and, in particular, those studies in which Australia has been involved.

The systematic study of relationships and processes in comparative research in education only emerged during the second half of the twentieth century. These cross-national comparative studies seek to increase understanding of how variables relate to one another, to explain better the processes of teaching and learning and educational change, and to investigate how such relationships and processes vary across countries and over time. The possibility of conducting such studies has emerged as a result of greater ease of movement by aeroplane, greater ease of communication by telephone, fax and email, and greater facility in the processing of data arising from developments in computer software. Nevertheless, cross-national studies of educational achievement are difficult and costly to conduct because extensive cross-national consultation is required. IEA has been the major pioneer of this type of investigation into the factors influencing achievement outcomes across the countries of the world.

The research program of IEA

In the late 1950s, a group of educational research workers meeting at the UNESCO Institute for Education in Hamburg saw the need for comparative studies of the relationships and processes operating to influence the educational outcomes of participation, achievement and attitudes. They recognised that there was generally insufficient variability within a particular country to detect, using existing methods of statistical analysis, the effects of specific factors on the outcomes of learning. They argued that if research studies could be undertaken between countries as well as within countries, and over time, then the greater variation that existed across countries and the different school systems within countries would permit the identification of common factors of importance that influenced learning outcomes.

The feasibility of conducting research studies into factors influencing educational achievement across countries was tested in a pilot study. The success of this study led to the establishment of IEA and its incorporation in Belgium. IEA initially operated for about a decade from the UNESCO Institute for Education in Hamburg, but moved to the newly established Institute of International Education at the University of Stockholm under the chairmanship of Torsten Husén early in 1970, where it remained for 20 years. In 1990, IEA moved to new headquarters in The Netherlands. The success of this major development in comparative research in education owes much to the wisdom and scholarship of Torsten Husén and to the drive and organising skills of Neville Postlethwaite, who started as Executive Director of IEA in 1963 and took over as chairman from 1978 to 1986.

The Australian Council for Educational Research (ACER) joined the IEA in 1963 under the direction of Dr W C Radford and at the instigation of Sir Fred Schonell, a Vice-President of the ACER Council and a friend and colleague of Torsten Husén. ACER participated in the First IEA Mathematics Study in 1964, with five of the six Australian States taking part. This drew ACER for the first time into an international study and brought to Australia new ideas about survey sampling and calculating sampling errors, new ways of testing using optical-mark-sensed answer sheets, the use of computers for data analysis, and new statistical procedures for the analysis of educational data. Furthermore, it led to the transformation and development of ACER's General Research program.

Over a period of more than 40 years, IEA has carried out a sustained program of research studies that have, in the main, been survey and cross-national investigations into factors that have an effect on educational achievement, participation rates and attitudes towards school and school learning. The data collected have been examined across countries, between schools within countries, and between students within countries. Where possible, relationships have been tested after controlling for other factors that might affect the educational outcomes under consideration. The specific relationships that have been tested each fall into one of several types, namely: (a) relationships between predictor and criterion variables across countries; (b)

similar common relationships between predictor and criterion variables at the levels of between students and schools within countries; (c) relationships between predictor and criterion variables at the levels of between students and between schools that are unique to a particular country or a small group of countries; (d) the absence of an observable relationship where current opinion had hypothesised that such a relationship should exist; and (e) change in levels of participation, achievement and attitude and in the magnitudes of relationships over time.

Before the systematic examination of relationships between students, between schools and between countries could take place, advances were necessary along three fronts. First, it was necessary for theory to be developed and models formulated of specific processes of school learning. Second, it was necessary for data to be collected that were sufficiently comparable across countries, so that the testing of models in a comparative manner was worthwhile. Third, statistical procedures for the testing of models had to be developed in order to provide strong estimates of effects and efficient estimates of error for the examination of statistical significance and size of effect.

Theoretical perspectives guiding IEA research

Several theoretical frameworks have guided the development of models in IEA research studies. From the Gränna Workshop conducted in Sweden by IEA in 1971, which examined in detail the seminal work *Handbook on Formative and Summative Evaluation of Student Learning* (Bloom et al, 1971), came the theoretical view of curriculum implementation that has been tested in several IEA studies. In this model the curriculum could be considered to exist at three levels: (a) the intended curriculum, (b) the implemented curriculum, and (c) the achieved curriculum, which were influenced by the antecedent and contextual factors as well as the learning conditions in schools and teaching practices. A second highly influential model in IEA research has been Carroll's (1963) model of school learning, which was tested empirically with respect to the study of learning French as a foreign language, and the learning of mathematics and science across countries and in Australian schools, and has formed the basis for causal models in several IEA studies. A third model that has guided IEA research has been a cross-national model of educational achievement in a national economy advanced by Dahllöf (1967). Of particular interest for policy making were the frame or structural variables. Moreover, their dependence on (a) the environment and the economy, (b) demand for personnel, (c) curriculum content, and (d) the objectives of the school system was argued on theoretical grounds by Dahllöf. However, only limited aspects of this

theoretical model have been tested in either primary or secondary analyses.

IEA studies have consistently recorded the marked differences in levels of achievement between developed and developing countries, with much lesser variation between the countries within each group (Inkeles, 1977). Furthermore, it has been shown that a causal model, which explained well the influence of individual student factors on reading achievement at the 14-year-old level in developed countries, was less than adequate in two developing countries, India and Iran. These findings suggested that there were different processes in operation influencing educational outcomes in developed and developing countries.

IEA leads educational research worldwide

The research activities of IEA have gradually, over time, had an important role in spreading the procedures of empirical research in education across the developed and less developed countries of the world. Over 50 countries are currently members of the organisation, and several additional countries have participated in particular studies over the past 40 years. From their participation, educational research workers in these countries, like those in Australia, have been introduced to new approaches to empirical research.

As statistical procedures for measurement and for the testing of models of causal processes have been developed, IEA has remained at the forefront of statistical analysis and has advanced and tested complex models to generate an understanding of the processes that operate to influence educational outcomes. It is noteworthy that such analytical procedures as blockwise regression analysis, partial least squares path analysis, and linear structural relations analysis were developed in collaboration with scholars at the Institute of International Education in Stockholm, who were working on the analysis of IEA data. Likewise, the advancement of procedures for the improvement of measurement of educational outcomes in large scale surveys, with equating across levels of test administration and over time, owed much to the IEA studies and to work done at the ACER. Furthermore, advances in resolving the problems of multilevel analysis have been stimulated by educational research workers engaged in IEA studies.

The key findings of the IEA studies

The IEA studies taken together have involved millions of students in testing programs, hundreds of thousands of schools, and thousands of research workers in the field of education from a wide range of

countries. In 2002, the membership of IEA continues to grow and its headquarters remain firmly established in Europe (although substantial financial support has been received occasionally, but not exclusively, from agencies and foundations in the United States). The school subjects involved in the IEA testing programs have included mathematics, science, civic education, reading, French as a foreign language, English as a foreign language, computing, literature and writing. In addition, there have been studies of Pre-School Education, and the Classroom Environment and Teaching Behaviours.

Key findings

The key findings from IEA studies that apply primarily to the developed countries may be listed, although Findings 1 and 10 relate more to the less developed countries, and Findings 2 and 3 to the more developed countries.

1. There are marked differences in average levels of achievement between the students in schools in the more developed countries (MDCs) and those in the less developed countries (LDCs). This occurs despite the fact that in the LDCs, less than 100 per cent of the relevant age groups are enrolled in school (Inkeles, 1977).
2. The average level of achievement within more developed countries at the terminal secondary school stage is inversely related to the proportion of the age group enrolled at school or participating in the study of the subject under survey.
3. At the terminal secondary school stage in more developed countries, when equal proportions of the age groups are compared, there are only small differences in levels of achievement, irrespective of the proportions of the age groups retained at school. The best students do not suffer with increased retention rates.
4. Student achievements in mathematics, French as a foreign language and science are positively related to the time given to the study of the subject at school, both in comparisons across countries and between students within countries.
5. The achievement of students is related to the time spent on homework after other factors influencing achievement have been taken into account.
6. The average level of student achievement across countries is positively related to the opportunity that the students have to learn the content of the items tested.
7. The level of reading resources in the home is positively related to student achievement, as are other indicators of language usage in the home such as the use of a dictionary and whether the language of the home is the language of instruction.
8. Measures of the socioeconomic status of the home are positively related to student achievement in all countries, at all age levels and for all subjects.
9. Although the effects of home background variables are similar across subject areas, the effects of the learning conditions in the schools differ between subject areas, and in some subject areas are equivalent to or greater in the size of their influence than the effects of the home.

Secondary and further analyses

10. In less developed countries (LDCs) the use of a textbook has an effect on student learning. However, the same effects have not been reported from studies in more developed countries (Heyneman & Loxley, 1983).
11. The role of women in society is related to gender differences in performance in mathematics. From a secondary analysis of IEA data from the First and Second IEA Mathematics Studies conducted in 1964 and 1982, Baker and Jones (1993) have shown a clear relationship between the increasing rate of participation of women in the labour force and the rate of reduction of gender differences in mathematics achievement at the lower and middle secondary school levels. This study provides evidence for a relationship between societal forces that influence participation in the labour force and educational outcomes in so far as differences between the sexes are involved.
12. Hanushek and Kimko (2000) have examined performance data on mathematics and science tests for 31 countries that participated in international studies of student achievement on at least one occasion, and measures of economic performance that are necessary for the estimation of both educational achievement and subsequent economic growth, respectively. Labour force quality differences as assessed by science and mathematics achievement outcomes are shown to have strong relationships with economic growth rates measured in terms of average real per capita GDP between 1960 and 1990. Four of the achievement studies involved were conducted in mathematics or science by IEA and two studies were carried out by the International Assessment of Educational Progress (IAEP). These testing programs provided data that were consistent across the countries under survey at the lower secondary school, 13 or 14 year-old levels. Quality of schooling as assessed by student performance in mathematics and science has a strong positive influence on economic growth, even when the East Asian countries are removed from the analyses.
13. Between 1970–71 and 1983–84, levels of achievement in science at the 10-year-old and 14-year-old levels advanced in most, but not all 10

countries that took part in the IEA studies on both occasions. These advances would appear to be related to the increased emphasis between occasions given to the learning of science in the countries involved.

14. Levels of achievement in mathematics at the lower secondary school stage in Australia between 1964, 1978 and 1994 declined significantly over time. However, these falls in performance did not occur in all states of Australia (Afrassa & Keeves, 1999).
15. No significant differences between male and female students in mathematics achievement at the lower secondary school level were recorded in Australia between 1964, 1978 and 1994. However, a significant decline in mathematics achievement was reported for boys between 1964 and 1994 but not for girls. This decline for boys was equivalent to nearly one year of mathematics learning, while the drop for girls was only equivalent to approximately half a year of mathematics learning (Afrassa & Keeves, 2001).

For more detailed accounts of the general key findings from the IEA studies and the more specific findings from particular studies, the report by Keeves (1995) should be consulted. Nevertheless, it is important that the vision of those who founded IEA for the advancement of research in a cross-national context is sustained at a time when the increased visibility of international educational achievement studies gives rise to serious misunderstandings, disputable conclusions for policy and practice, and undue emphasis on the rank ordering of national achievement (Beaton et al, 1999). With the great advances in computer software for the analysis of data using multilevel and multivariate procedures that have occurred during the past decade, it would seem highly desirable that more attention be given to the examination of the rich and extensive bodies of data that are currently inadequately analysed.

Conclusion

Each of the major IEA studies has generated hundreds of reports, written in the different languages involved, to inform the teachers and educators in participating countries of the findings that apply worldwide and in particular countries. Consequently, it is not possible to present a full account of all the factors that influence differences in educational achievement between countries, within countries and over time. Sometimes the findings are controversial, sometimes for political purposes, in particular countries, they have not been released, and sometimes the data from a particular study has not been fully analysed because of shortages of funding, change-over of staff and lack of technical and statistical skill. Nevertheless, the research studies conducted by IEA have transformed the nature of the

field of comparative education, changed the way many educators think about educational problems, and slowly changed both educational policies and practices in a worldwide context.

The expansion of IEA programs to monitor change and to identify factors influencing learning in the fields of literacy, science and mathematics education, as well as the increased use of computers and information and communication technology in a learning society, calls for research studies that will contribute to the resolution of the many problems that confront human development across all countries of the world.

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Understanding mathematics classrooms internationally: the Learner's Perspective Study

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Situating the Learner's Perspective Study

This paper reports recent research into the structure of mathematics lessons in Australia, Germany, Japan and the United States. The analysis of video data collected in the video component of TIMSS (Stigler & Hiebert, 1999) centred on the teacher's adherence to a culturally-based 'script'. Central to the identification of these cultural scripts for teaching were the 'lesson patterns' reported by Stigler and Hiebert for Germany, Japan and the USA, and the contention that teaching in each of the three countries could be described by a 'simple, common pattern' (Stigler & Hiebert, 1999, p. 82). The particular results from the Learner's Perspective Study reported here are based on analyses of sequences of 10 lessons, documented using three video cameras, and supplemented by the reconstructive accounts of classroom participants obtained in post-lesson video-stimulated interviews.

This methodological approach offers an informative complement to the survey-style approach of the TIMSS and TIMSS-R video studies. A research design predicated on a nationally representative sampling of individual lessons, as in TIMSS and TIMSS-R, inevitably reports a statistically-based characterisation of the representative lesson. A more fine-grained study of sequences of 10 lessons, informed by the reconstructive accounts of the participants, has the potential to address:

- consistency of lesson structure over a 10-lesson sequence;
- degree of variation in lesson structure in the practices of competent teachers;
- the extent to which any such variation is linked to the location of the lesson in the instructional sequence and to the teacher's instructional intentions;

- student awareness of the structure of the lesson and how this is related to their perception of significant educational moments in the lesson and to their subsequent learning.

In this paper I will primarily address the first three of these points. Analysis with respect to the fourth point will be reported to the extent that it informs our understanding of the structural patterns evident in answering the first three questions. But first, any such discussion of lesson structure must be situated in relation to recent international comparative research and in relation to considerations of culture.

The appropriate accommodation of culture

Research into international differences and similarities in student mathematical performance (such as TIMSS and PISA) has limited utility, except as a form of national report card, unless it is accompanied by data that suggest cultural, societal or instructional variation that might be used to explain such differences and similarities and then to promote improved mathematical learning and associated performance. One of the difficulties in constructing such explanations is the interdependent character of cultural and social practice, the cultural specificity of instructional practice, and the social mediation of cultural values and curriculum emphases in schools and classrooms.

Given the success of Asian countries in international tests of student achievement, three key assumptions underlie current enthusiasm for the adaptation of Asian classroom practices for non-Asian use: (a) that the performances valued in international tests constitute an adequate model of mathematics, appropriate to the needs of the less-successful country;

(b) that differences in mathematical performance are attributable to differences in instructional practice (and not to differences in culture, societal affluence or aspiration, or curriculum); and (c) that the distinctive instructional practices of more successful countries (should these exist) can be meaningfully adapted for use by less successful countries. Each of these key assumptions can be problematised on a variety of grounds (eg, Clarke, in press; Westbury, 1992). Our research must do more than document occurrence, whether it is of student achievement, curriculum content, teacher action, lesson structure or teacher and student belief. Our research must investigate the interrelationship of these things rather than simply assume their correlation.

From the studies that have been done, we have every reason to believe that it is in these interrelationships that the character and function of culture will most clearly emerge: in the teacher practice that mediates between curriculum content and the student, through the actions and the lesson structure that constitute the enactment of that curriculum in the classroom, together with the beliefs and expectations on which the student's participation is predicated, culminating in the learning of which student achievement is the most obvious demonstration. Culture is not outside these things. It is in the combination of these and other elements that culture itself is constituted. Nor is culture a synonym for nationality. As several studies have shown, the practices of the classroom can be constructed differently within a particular country or school system. These classroom practices are a reflection not just of an enveloping dominant culture, but also of the contributing cultural affiliations of the classroom participants. There are, however, cultural values and beliefs that frame each country's educational endeavours. International comparative research must do more than document cultural differences, it must accommodate them. The Learner's Perspective Study that generated the analyses reported here was designed to provide this accommodation. The methodological details of the Learner's Perspective Study can be found in several of the papers available through the project Website: <http://www.edfac.unimelb.edu.au/DSME/lps>.

In his re-analysis of data from the Second International Mathematics Study (SIMS), Bracey (1996) suggested that the differences in mathematics performance found at an international level were replicated in a partitioning of the US sample along cultural or ethnic lines. As a simple illustration of this point: Asian-American students, participating in a school system that has been substantially maligned in the US popular press, perform at a level comparable with their high-performing counterparts in schools in Asian countries. This single illustration suggests that differences on particular measures of mathematical performance are

at least as attributable to the cultural affiliation of the students as to the particular school system attended. The significance of such internal cultural variation is lost in the aggregation of performance data for countries as culturally plural as the United States, Australia or Canada. Such analyses also have implications for societies with a small number of substantial ethnically-distinct communities, such as Malaysia and South Africa.

Berliner reiterated this point in an article in the *Washington Post* (January 28, 2001, p B3). That is, rather than serving an agenda of international competitive comparison, the results of international achievement testing can be analysed to identify members of a nation who are less well served by the school system than others.

But what are the implications from the perspective of cultural traditions? Analyses reported by Bracey (1996), Berliner (2001) and Hu (2000) suggest that the cultural affiliation of the learner (whatever their geographical location) is at least as important as the cultural alignment of the school or school system and certainly should not be simplistically identified with nationality.

Educational research has increasingly drawn our attention to the importance of the social processes whereby competence is constructed and in which competence is constituted (for both teaching and learning). The agency of the student, the nature of learner practice, and the cultural specificity of that agency and that practice must be accommodated within our research designs. This accommodation was a priority in the Learner's Perspective Study.

The remainder of this paper summarises the results of the analyses of lesson structure in Japan, Germany, the United States and Australia. In the case of each analysis, the attempt to apply the original TIMSS 'Description of Activity' codes to the lessons from the LPS (in order to facilitate comparison of the results from the two projects), caused a process of refinement and adjustment of categories. This was particularly necessary because the data from the Learners' Perspective Study focus on the students' actions in addition to the teacher's activities.

The structure of mathematics lessons in the United States

The first TIMSS Videotape Classroom Study reported the United States lesson pattern as: (a) reviewing previous material by checking homework or doing a warm-up; (b) demonstrating how to solve problems; (c) practicing; and (d) correcting seatwork and assigning homework (Stigler & Hiebert, 1999). In contrast, the Japanese lessons appeared to follow a different script, which can be characterised as

'problematising'. The teacher poses a complex and thought-provoking problem; students work on the problem; various students present their solutions to the class; and the teacher summarises the class' conclusions.

Joanne Lobato's analysis of Learner Perspective Study (LPS) data suggests a more complex view of the structure of US mathematics lessons. Results from two US schools reveal significant differences in the lesson patterns across the two schools, variability of lesson structure within a school, and important differences from the lesson script identified in the TIMSS study.

Lobato began analysing the structure of the US lessons by using the categories from the TIMSS study: 1) doing and discussing a Warm-Up (WU); 2) Correcting Homework (CH); 3) Presenting a Formula, procedure, definition or terminology (PF); 4) working Examples with the class (E); 5) Practicing (P); and 6) Assigning Homework (AH). She found, especially for School 2, that her analysis also needed the following categories of activities typically found in Japanese lessons: 7) Presenting a thought-provoking Problem (PP); 8) Working on the Problem individually or in groups (WP); 9) Presentation by Students (PS); 10) Discussing Solution methods (DS); and (11) Highlighting and Summarising the main point of students' work (HS). Finally, seven new codes were needed: 12) teacher Presents Concepts, connections or patterns (PC); 13) Guided Development (GD); 14) Review for a Quiz or test (RQ); 15) take a Quiz or test (Q); 16) Correct a Quiz or test (CQ); 17) Correct Seatwork (CS); and 18) Administrative Announcements (AA).

The lesson script reported in the TIMSS Study (namely WU or CH; PF and/or EP; P; CS and AH) did not appear in any US lesson, though significant portions of it appear in Lessons 1–6 in US School 1. More significantly, in eight of the lessons the teacher engaged in an activity, which we are calling 'guided development' (GD). Rather than presenting definitions, patterns and connections, the teacher elicited these from the students. This differed from the 'problem presentation' and 'working on the problem' activities found in the Japanese classrooms in that the problems were 'smaller' and there was greater teacher control. However, the 'guided development' activities allow for more student input and greater opportunities for conceptual development than the 'present a formula' or 'work examples' categories. The analysis of US School 1 data suggests that an experienced US teacher may be more flexible in following the lesson pattern, depending on the phase of the entire unit. The analysis of US School 2 data revealed the frequent use of activities that were regarded as typical activities in Japanese lessons, namely presenting a thought-provoking problem', 'working on the problem in groups', and 'presentation by students'. While the underlying characteristic of 'problematising' was

evident, the activities were treated with a slightly different style than was the case in Japanese classrooms.

Capturing the structure of Japanese mathematics lessons

Yoshinori Shimizu and his colleagues have examined how Japanese teachers approach teaching mathematics in the structured problem solving mode and how their students perceive such lesson structure (Shimizu, 2002a & 2002b). Special attention was given to those findings that relate to the emphasis in the classrooms on discussing alternative solutions to a problem in the recurring lesson pattern, as these were the features that appeared to make Japanese lessons different from the other two countries, Germany and the United States in the first TIMSS Videotape Classroom Study.

The cultural script for Japanese lessons identified by the TIMSS Videotape Classroom Study seems to fit the typical Japanese framework for writing a lesson plan. One of the origins of such a cultural script would be in the traditional use of such a lesson plan framework by Japanese teachers in planning and implementing lessons. On the other hand, the data from the LPS project suggest that an experienced teacher may be more flexible in following the lesson pattern, depending on the phase of the entire unit or on the state of the students' understanding of the topic taught.

The lesson's position within the lesson sequence was clearly related to the connections constructed by teachers between lessons and to the structure of each actual lesson itself. The lesson structure can be varied within the entire topic unit, depending on the particular phase of the lesson sequence. For example, a lesson at the introductory phase of the entire unit can be in the structured problem-solving mode, whereas the lesson at the final phase of the unit can be focused on practicing what the students have learned. The Japanese analysis of videotaped sequences of 10 consecutive mathematics lessons suggests the need to explore the 'lesson structure in the sequence of lessons' in more detail.

The use of post-lesson video-stimulated interviews with students and with the teacher provided the opportunity to document Japanese student and teacher perceptions of lesson structure. These proved very informative. While Japanese teachers may devote considerable effort into the planning and structuring of their lessons around a yamaba (the climax of a lesson), the students may perceive these structures differently, or not at all. The methodology employed in the LPS offered students the opportunity in post-lesson video-stimulated interviews to 'parse' the lesson they had just experienced. That is, the teacher and the students interviewed after lessons, were given control of the

video replay and asked to identify and comment upon classroom events of personal importance. In many instances, Japanese students identified as significant classroom events quite different from those intended by the teachers. In one particular case, for example, the teacher identified nine elements in the lesson to be significant, while each of two students interviewed identified eight and seven elements respectively. Although the numbers of elements identified as felt to be significant were similar between the teacher and two students, the locations of these events in the entire lesson were different. Only four elements were identical among the three accounts of the same lesson.

Lesson patterns in three German mathematics classrooms

As was the case with the Japanese LPS data, one aim of the analysis of the German classrooms studied in the Learner's Perspective Study conducted by Eva Jablonka was to identify the similarities and differences to the 'scripts' identified in the TIMSS Videotape Classroom Study and whether the lesson structures identified by the observer, by the teacher and by the students correspond.

The German lessons analysed in the TIMSS Videotape Classroom Study showed a tendency to fall into two main parts: an 'acquisition' and an 'application' phase (Stigler et al., 1999). The three Berlin classrooms from the LPS also show phases that could be labeled as acquisition or application. In addition, these two categories apply to whole lessons within the structured sequences of lessons from the LPS, while some lessons show the same pattern repeated several times as a substructure. A closer look at the enactment of the 'acquisition' phase revealed characteristic similarities in all three German schools studied in terms of social interaction, corresponding to a description used in a common lesson planning framework in Germany. In this framework the interaction is labeled as *Fragend-entwickelndes Unterrichtsgespräch* (questioning-developing classroom talk). It has similarities to the activity found in one of the US schools and described as 'guided development' by Lobato (next section). Two of the classrooms from the German LPS data show remarkably long phases devoted to the sharing of homework motivated – according to the teachers' explanations – by the conjecture that otherwise the students were not likely to complete their homework.

The descriptions of the lesson structure, of those lessons that were judged by the students to be typical, show an extremely high level of correspondence among the students. This perceived lesson structure seems to be associated with individual teachers. However, the correspondence between the teacher's perception of the structure of some lessons and that of the students is less obvious.

Characteristic features of mathematics lessons in Australia

As is typical of so much of international comparative research (see Clarke, in press), the Australian lessons studied share some of the more obvious features with their overseas counterparts (such as the consistent use of introductory revision); appear to differ significantly in others (such as the almost complete lack of student demonstrated solution to the whole class); and, at the level of intention and meaning, may involve apparently similar activities to those employed overseas, but which are predicated on entirely local pedagogical principles.

The picture of constrained variation of practice reported for the Japanese data was also evident here. The acquisition and application pattern reported for Germany by Stigler and Hiebert could be detected but, as with the German LPS data, was variously employed. In line with the US and Japanese lessons, group work on a thought-provoking problem was also used on occasions. Perhaps the most distinctive characteristics to emerge from comparison of the Australian lessons with their US, Japanese and German counterparts were the extremely high levels of student–student interaction as structural features of the mathematical activity of every lesson and, associated with these periods of student–student interaction, the thorough and extensive one-on-one interaction between the teacher and virtually every individual student at some point during such periods of individual or collaborative mathematical seatwork.

Earlier analyses of Australian mathematics classroom practice (Clarke, 2001) documented the extent to which student–student interaction was a major component of mathematics lessons and one which teachers tacitly or explicitly exploited in achieving their pedagogical goals. It would certainly be inappropriate to characterise the Australian mathematics lessons in the LPS data by a 'simple, common pattern', however there do appear to be pedagogical principles on which the Australian lessons are commonly predicated, and these implicit principles are likely to provide a better characterisation of the cultural basis of Australian mathematics teaching than any particular lesson pattern or prevalent instructional activity.

Concluding comment: mirror not blueprint

Watanabe (2001) quotes White (1987) as writing 'we should hold Japan up as a mirror, not as a blueprint'. This powerful and appealing metaphor can serve as a general characterisation of one of the major uses of international comparative studies of classroom practice. We are encouraged to study Japanese (or

American or German) classrooms not solely for the purposes of mimicking their practices but for their capacity to support us in our reflection on our own practice. The mutuality of the potential benefit provides further motivation for such research.

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Information and communication technologies in classrooms: perspectives from an international study

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In the school programs area, Dr Ainley has conducted a range of research studies including: the definition and measurement of the socioeconomic status of school students published under the title, *(Socioeconomic Status and School Education, 1995)*; the achievements and attitudes to school of students in the primary school years (*Primary Schooling in Victoria, 1990*) with continuing involvement in research on factors that influence the quality of school life for students and the social outcomes of schooling (*Schools and the Social Development of Young Australians, 1998*). Dr Ainley is currently National Research Coordinator for the Schools Around the World project that compiles and analyses samples of student academic work in science and mathematics from Years 4 and 8 in nine countries. He is also National Research Coordinator for Module 2 of the *Second Information Technology in Education Study*, which involves a series of case studies of innovative teaching and learning practices that use information technology.

Diana Banks is a Senior Research Fellow at the Australian Council of Education, with particular expertise in the area of educational ICT. She is currently preparing several of the case studies for Australia's participation in the Second IT in Education Study (Module 2). As well as her work with ACER, Dr Banks is an adjunct professor at the University of Canberra. She works as a consultant to Australian education systems, mostly in the area of educational ICT.

Banks has been an early childhood specialist as well as a school principal. She championed the systematic introduction of educational ICT to schools when she was an executive member of the ACT Department of Education between 1992-1996. In this role, she promulgated standards and protocols for school hardware and software, and established seed funding programs to encourage schools to take an innovative approach to ICT for learning and teaching. Her leadership at that time also led to all ACT schools being connected to the internet, the first Australian school system to do so. Later, Dr Banks became the Assistant Secretary of the Office of Government Information Technology which is an Australian Federal government agency. From 1996-1998, she managed the development and implementation of the Federal government's online service strategies.

Marianne Fleming is a Research Officer at ACER where she has contributed to several reports and articles on career development among adolescents and secondary schooling in Australia. She co-authored the two national surveys of School-Industry programs for the ASTF. Other accomplishments include her contributions to the national report on Subject Choice in Years 11 and 12, a project on the development of occupational interests among school students and the adaptation of a computer-based vocational guidance program (SIGI Plus) for use in Australia. Ms Fleming was also involved in two evaluations undertaken on School Annual Reports for the Victorian Department of Education. Most recently Ms Fleming has been working with the Catholic Education Commission of Victoria on a longitudinal study of literacy programs in the early years of schooling and a qualitative study of innovative pedagogical practices in schools using ICT.

Many countries have envisaged a significant role for information and communication technologies (ICT) in their education systems. For example, in Australia one of the goals in the declaration of the Ministerial Council on Education, Employment Training and Youth Affairs on national goals for schooling stated that students should be: confident, creative and productive users of new technologies and understand the impact of those technologies on society (MCEETYA, 1999). A national action plan, Learning in an Online World, has set three priority areas for development: making available connections of sufficient bandwidth to allow schools to integrate online services into curriculum practice; providing effective pre-service education and ongoing development for teachers; and developing high quality online content (EdNA, 2000). An information gateway provides access to relevant resource materials (Lonsdale, 2002). However, even among innovative schools there is wide variation in the ways in which

ICT is utilised (Cuttance, 2001). In most countries there are a few schools that have been innovative in using ICT to change teaching practices. The IEA project, the Second International Technology in Education Study (SITES) Module 2 (M2) is a study of innovative teaching practices that are supported by the use of ICT.

Methodology

International

SITES M2 was designed to identify and describe innovative technology-based teaching practices in ways that might inform wider implementation, inform policy decisions related to ICT in schools and provide new ideas for the use of ICT in classrooms. It was conducted over the period from October 1999 through to July 2002. There were 28 countries involved in SITES M2. In total, the study generated 174 case studies. In these cases technology played a substantial

role; there was evidence of changes in the roles of teachers and students and there appeared to be positive student outcomes, where the practice was sustainable and transferable.

SITES M2 was essentially a qualitative study in which case study methods traditionally applied to small numbers were scaled up to encompass a large number of cases. In each country, common selection criteria (with the option for local modification) were used to identify innovative practices. A common set of methods was used to gather and analyse qualitative data about teaching practices, student learning the role of ICT in teaching and learning. Case studies were conducted using a common set of data collection instruments and analysis protocols. Researchers spent at least one week at each site observing classrooms, interviewing participants, conducting focus groups, gathering materials, products and documents and administering surveys. A data matrix format was used to reduce and organize the data. The matrix was then converted to a narrative account following a standard structured format. Typically a 10-page narrative for each case resulted. Finally, a number of quantitative analyses were used to identify trends and patterns in the narratives and to highlight examples that were explored in greater detail.

National

Selection and data gathering

To select cases a national panel of seven people was established. Those people provided experience in school system administration, knowledge of classroom practice and experience of research or evaluation studies related to ICT in schools. To be selected a case needed to show evidence of substantial change in student and teacher roles in pedagogy; involve a substantial role for ICT, show evidence of positive student outcomes and provide an expectation of being sustainable and transferable, and be innovative. In Australia innovative

was interpreted as providing for enhanced student engagement and connections with other learning areas and contexts. Visits extending between one and two weeks were made to schools. Questionnaires were administered, interviews were conducted with school personnel and observations were made of the innovation in action. Photographic records and (in one case) videotape records were made. Table 1 contains an outline of the schools selected for study.

Case summaries

Cinderella is just-in-time: integrating English and History. The novel *Chinese Cinderella* was the basis of a two-week integrated English/History unit for Grade 7 students at Toorak College in Victoria. Students investigated and analysed the lives of girls and women in China as they were portrayed in the novel. They were free to choose which resources to access, how to structure their approach to the task, and with whom they would work, and sought 'just-in-time' assistance from their teachers as they progressed. Students used a wide variety of ICT tools including Access Tool Box, Microsoft Front Page, MediaGram and digital cameras to develop personal e-portfolios that they stored on the school's intranet. In some instances, they were already quite adept at using the ICT as a result of their previous years at the school. However, they also used new kinds of ICT and developed new skills during this project, for example inserting sound and image files or simple programming to animate characters. Teachers designed an 'Ancient China WebQuest' which formed the preliminary support to students' research. The project was also used as a professional development programme within the school. All lessons were videotaped and documentation was available on the school's intranet.

Using multi-media development tools to foster learning styles. The Grange School in South Australia is a Reception to Grade 7 setting that uses ICT to emphasise growth in students' learning styles rather

Type of school	Socioeconomic context	Grade level of innovation	Subject areas involved	Description
Independent K-12	High SES	Grade 7 (ages 12-13)	History, English	Authentic learning in middle years using on-line multimedia technology
Government	Middle SES Primary K-7	Grades K-7 (ages 5-13)	All subjects	Uses multimedia development tools with a focus on approaches to learning.
Government cluster of 49 schools	Varied	Grades 9-12 (ages 14-17)	Range of subjects	A virtual schooling service involving extending opportunities for secondary school students.
Government K-9	Low to middle SES	Grades K-9 (ages 5-14)	All subjects	ICT plays a central role in school approach to teaching and learning
Government K-12 plus two K-6	Low SES	Grade 6 (ages 11-12)	Not subject related	Orientation programme for primary students moving to secondary schools

Table 1 Case study schools and innovations

than to present subject matter. The catalyst for this profound shift in pedagogy came about when Grange School was selected by the South Australian government in 1999 to be a demonstration site of good practice for the integration of ICT. As a consequence, this technology rich environment enabled teachers to question current pedagogy and continually ask how it can be improved. The school has 160 computers for 650 students, all connected to a local area network. A wide variety of software is used including HyperStudio, KidPix, Inspiration and iMovie as well as the standard Microsoft applications. Digital equipment and peripherals are also used regularly. Curriculum topics are often addressed through a critical question that students are asked to investigate. Students are organised into learning teams that change according to the task at hand. The particular technologies that students use demonstrate an evolving sophistication. For example, in Grades 1/2, students make use of Websites to conduct research. They use email extensively. By Grades 6/7, students produce iMovies, preparing scripts and making and editing videos. The use of peer tutoring in the use of ICT and a 'skill register' means that there is a great deal of interactive learning between students without the direct intervention of teachers.

Electronic distance education. Students in Grades 9, 11 and 12 in Queensland's high schools can access six subjects entirely online through the Virtual Schooling Service (VSS) as a pilot of new distance learning strategies. A Virtual Private Network links all government schools in that state and makes the programmes possible. VSS teachers use a range of software to provide course materials and conduct the learning sessions. The key software is NetMeeting Whiteboards, Microsoft Power-Point, and interactive spreadsheets to facilitate group discussion and WebQuest to design learning tasks. Students participate in two weekly synchronous lessons with their teacher and classmates scattered around the state. They also undertake three off-line Study Room sessions each week. These online courses allow students to study subjects that are not offered at their own schools, often because they are located in rural and remote areas in Queensland where student numbers are small. Schools support their VSS students in many important ways, perhaps most critically through the nomination of a teacher as Study Coach for each subject the student undertakes. Many lessons are being learned about the consequences of electronic remote learning strategies for optimal timetabling arrangements (at the school and by the central provider), technology standards, and managing students at risk.

Building a learning community. Woodcrest College is a new Kindergarten-Grade 9 school that has been able to plan the integration of ICT into programmes from the outset. Students are grouped into four multi-age

bands, and the curriculum is organised around themes. Teachers work in teams and students are involved in collaborative learning. There is a Learning and Development Centre for Technology at the school providing professional development for teachers. The school has 300 computers for a student population of 1,100, all connected to a local area network. Software holdings are extensive including Microsoft Office, AppleWorks, KidPix Studio, and iMovie Digital Video together with a variety of digital technologies such as Lego Robolab. Teaching is based around broadly defined themes. Students share ideas about what they would like to learn within these themes and teachers take these ideas to flesh out the learning programmes each term, assisted by two ICT experts at the school who suggest how ICT might best be incorporated into the proposed programmes. Students work in groups but develop electronic portfolios of their own work that are the basis of assessment by teachers and used to showcase their work to parents. Each term, teachers move from being instructional designers and facilitators, to becoming advisors and mentors. Teachers new to the school experience a period of adjustment to Woodcrest College's deeply embedded philosophy of ICT-across-the-curriculum approach.

The Virtual Bridge: an online orientation programme. St Mary's District High School in Tasmania uses a process of sustained electronic communication as part of its orientation programme for the Grade 6 students in three small, remote feeder primary schools. After an open day at St Mary's for all prospective students and their parents, the Grade 7 coordinator at the high school establishes personal contact with each of the prospective students using the Virtual Bridge facility. The Tasmanian government has a Virtual Private Network linking all government agencies, including its schools. The Virtual Bridge relies on this network for secure transmissions between the students and the Grade 7 coordinator. The fundamental software is WebQuest. Contact between participants is in the form of email, and through chat rooms. The Grade 7 coordinator engages in a series of quite informal communications with individual students and, by so doing, learns a great deal about them, their interests, and concerns about and expectations of high school. The information that flows helps in the decision making about suitable groupings of students in their first year at high school. Grade 6 students in the three primary schools are also encouraged to email each other and, as a consequence, they make new friends and get to know about their prospective classmates. The skills that Grade 6 students practice using the Virtual Bridge stand them in good stead for their learning at St Mary's, where parts of, if not entire, courses are provided online. Teachers in these schools have also realised that this simple model based on WebQuest offers an almost unlimited range of possibilities for online learning through shared teaching resources between themselves and other Tasmanian schools.

Case analysis

Framework

One framework that was used to analyse the cases focused on two dimensions. The first of these dimensions concerned how technologies were used. The technologies that were being used were examined and the uses that were made of them were coded using a classification of technology applications in education based on a proposal by Rubin (1996). Rubin's tool category entails 12 ways in which the computer could be used in the classroom as a means of enhancing student learning. The 12 categories identified by Rubin were initially condensed to four broad categories*. The categories were information resource tools, authoring tools, knowledge construction tools and knowledge reinforcement tools. The distinction between authoring and knowledge construction is not always clear because authoring involves some knowledge construction. For this investigation, where the emphasis was on the process of investigation in order to establish patterns, trends or generalisation, it was classified as knowledge construction. Where the emphasis was on organising material for the purpose of communicating to others, the activity was classified as authoring. Thus the categories were:

- *Computers as information resource tools* – Computers provide access to a greater and constantly expanding information base through the Internet, the World Wide Web and CD-ROMs.
- *Computers as authoring tools* – The computer and associated software provide students with the tools to work with and present information in different and creative ways. Examples include word processors, spreadsheets, presentation packages, graphics, multimedia and virtual classrooms.
- *Computers as knowledge construction tools* – A variety of software is available that allows students to explore knowledge and learn by constructing their own knowledge. Such software includes MicroWorlds, Inspiration, Lego LOGO and Tabletop.
- *Computers as knowledge reinforcement tools* – Computers may be used for drill and practice activities to reinforce basic skills and the learning of factual information. Typing programs such as SuccessMaker, and educational games such as 'Where in the World is Carmen San Diego?' are examples of these.

The second dimension of the framework concerned the teaching and learning processes that were involved. To begin, student and teacher activity during the period when our observers were in the school was summarised. From those descriptions of activities the nature of the teaching and learning processes that were involved were inferred. Teaching and learning processes

were coded using the taxonomy for learning, teaching and assessing proposed by Anderson and Krathwohl (2000). This taxonomy is based on levels of complexity on two dimensions: a knowledge dimension and a cognitive processing dimension. The knowledge dimension encompasses the following aspects:

- factual knowledge – the basic information required for a subject, unit or theme;
- conceptual knowledge – the way in which basic information connects with other more complex systems (such as theories and classifications);
- procedural knowledge – methods for doing something and the knowledge of the criteria used for these (such as procedures for conducting a science experiment or methods used to produce a graph); and
- metacognitive knowledge – knowledge about cognition as such and also self-awareness about one's learning.

The aspects for the cognitive processing dimension include:

- remembering – which includes recognition and recall;
- understanding – constructing meaning from a range of information (may be demonstrated by summarising, comparing or classifying, for example);
- applying – carrying out or using a procedure in particular situations;
- analysing – investigating material or information;
- evaluating – assessing a product, process, etc using specified criteria; and
- creating – which may involve producing a product, planning or designing a product or procedure or generating hypotheses.

The classification does not explicitly refer to social knowledge or social learning. Anderson and Krathwohl (2000, p. 41) emphasise the perspective that knowledge is domain specific and contextualised and that it should reflect 'the role that social experiences and context play in the construction and development of knowledge'. Despite this recognition, the emphasis in the taxonomy is on the interaction of the person with content, rather than between people and content. Some aspects of social learning involving ICT in the case studies were captured even though they were not explicitly part of the taxonomy.

Information and communication technology tools

In all the case studies, the use of the tools varied from lesson to lesson and from activity to activity. However, Table 2 contains a summary of the main emphases in each of the cases. The general classification is elaborated through examples of the use of ICT tools in each of the categories.

Case	Information resource	Authoring	Knowledge construction
1	Students sought and obtained information from intranet and Internet; interact with consultant and author.	Students used a range of ways to construct and present their information. PowerPoint and Word were used for multimedia presentations.	'Inspiration' was used to visually organise thinking during a brainstorming session and explore ideas.
2	Students used the Internet to find information.	Students used a variety of software to present and work with information.	Inspiration was used for mind mapping exercises and planning and analysis processes.
3	WebQuest used in economics.	Audiographic conferencing Electronic whiteboards as a tool to facilitate discussions.	
4	Year 3/4 class used the Internet to research aspects of Earth and Space.	Students used a video camera, then imported the video into a computer to be edited. Procedures and materials (of the science experiment) were then added. A range of software is available at the school.	Students used MicroWorlds to program and create 2D patterns involving revolving shapes such as circles and squares (eventually the aim will be to produce an animation of an astronomical concept); Inspiration is used for concept mapping. Lego Robolab and Control Laboratory are available.
5	Students to obtain information about high school and students who would be their peers. It also enabled the coordinator to obtain information about the incoming students.		

Table 2 Use of ICT as tools in case study schools

Information resource

In Case 3, information technology tools are used as both an information resource and for authoring in varied ways depending on the subject. ICT is used to receive and retrieve information and also to prepare material that is then submitted through the network to the instructor. In Case 5 the tool was used primarily as an information resource. All Grade 6 students in the three innovation schools regularly logged on to the *Virtual Bridge*, to send emails to their e-pals at the other schools and to participate in chat rooms with other Grade 6 students. They also emailed their Grade 7 coordinator, asking questions and responding to questions from the coordinator. Most teachers in the innovation schools have laptops that attach to the school network, and all classrooms have several PCs and peripherals.

Authoring

There was widespread use of the tools for authoring. In Case 1 students set up e-portfolios on the school's intranet. They created an electronic illustrated timeline of Chinese history showing key events and Dynasties using the Access Tool Box to retrieve the data chart and using the copy/paste tool to record information from the Net into their own document. Students utilised search engines to help find the relevant information and undertook a library catalogue search online. They downloaded illustrations from sites into their

document and participated in a WebQuest activity. Students used a bulletin board to communicate and collate questions within the classroom that were then posted to the Chinese curriculum consultant. To share their learning and understanding with others, students created a multimedia presentation. In Case 2, ICT applications include a number of software products designed for school age users, software used as standard applications in business and the development tools used by multimedia and Web developers. However, students in the focus group observed that 'we don't use them for the multimedia high-tech stuff, we just use them for typing stories, poems, wordprocessing, graphics'.

Knowledge construction

In Case 4, students work on units of work and focus on producing a quality product each term that illustrates what they've learnt from the unit that has been undertaken. Each term the project progresses through phases, including: researching the project or problem; designing the process for reaching a solution; accessing and organising the information needed; reflecting on what is being done; and producing the quality product. For example, in one of the observations the Grade 4/5 classes were studying the unit 'Earth and Space'. Two groups performed science experiments with student teachers. One experiment was conducted outside in a sandpit. Students made a

slope out of sand and poured buckets of water onto the slope. Students observed how valleys formed and answered questions about the experiment. The other group used the digital video camera to record 'making rain indoors' using ice in a saucepan over heat. The video was imported into the computer and edited, and procedures and materials added to show how to conduct an experiment. Another group used the Internet to research aspects of earth and space and to begin thinking of an experiment to conduct for the Science Fair (the Quality Product for the term). The fourth group read a book about laboratory experiments together with one of the teachers and discussed this.

Knowledge reinforcement

One of the general observations is that these tools were not used for knowledge reinforcement in an obvious or noticeable way in any of the cases. The use of ICT tools in the forms that is found in integrated learning systems is not typically nominated as innovative, even though it has often been found to be effective when used for that purpose.

Teaching and learning approaches

Examining the teaching and learning approaches involved in each of the cases was a high-inference activity. Moreover, the cases were schools and the emphases differed across units of work being

undertaken. In all the case studies the objectives varied from lesson to lesson and from activity to activity. Table 3 indicates the interactions of the knowledge and cognitive process dimensions that were used to guide the analysis of what happened in the cases. It contains very brief illustrations of aspects that were observed in the cases.

Knowledge objectives

In Case 1 the innovation teachers designed an integrated 'History and English' unit of study. The students read the novel *Chinese Cinderella* then investigated and analysed how the lives of girls and women in China are governed by the structures of history. Students resolved essential questions focused on examining their understanding of the lives of women in other cultures and how they compare to the lives of women in their own culture and timeframe. However, the focus was on the student researching, processing and analysing information as well as reflecting and collating what they had learnt. The use of information technology was fundamental to student access and response to unit material and collaboration with the other students. Teachers used an e-learning lesson planner matrix with the Anderson cognitive dimension placed on one axis and Gardner's Multiple Intelligence categories (Gardner, 1993) on the other. Students were involved in online discussion activities, for example with the Chinese Curriculum Consultant.

Cognitive process	Type of knowledge			
	Factual	Conceptual	Procedural	Metacognitive
Remembering	Used the Internet to research aspects of Earth and Space			
Understanding	Used software to communicate their understanding			
Applying			Conducted science experiment and included findings in an ICT presentation	
Analysing		Analysed how the lives of girls and women in China are governed by the structures of history	Self-assessment tasks that encouraged students to reflect on their learning process	
Evaluating			Panels of students assessed ICT presentation using a rubric that the class had agreed	Assessment based on students being engaged in monitoring their own progress
Creating		Students created an electronic illustrated timeline of Chinese history		

Table 3 Classification of teaching and learning categories with examples

In Case 2, teacher–student interactions frequently demonstrate a belief in the ability of students to make critical decisions about their own learning. The school has instituted systems that formally recognise the ability of students to play a leading role in the teaching of others. Assessment practices combine self-assessment, peer-assessment and teacher-assessment and the form of assessment as well as the curriculum objectives are negotiated between student and teacher. The structure of the learning activities, the nature, content and length of the activities are all seen as opportunities for students to be engaged in decision making about their own learning. Working on projects also provides opportunity for reflective journal writing about the conduct of the project. In a Grade 1/2 class, students were observed investigating Websites while researching the concept of space. The lesson began with the class seated on the floor of their classroom while their teacher explained the range of activities, all linked to the concept of space, that they could use during the lesson. After the explanation the students then began on various tasks. Some students were looking at a box of books determining whether any of them suited the category of space, others resumed a writing task they had been doing previously, and one group used the computers located in the room. Their teacher had identified suitable Websites relevant for the topic and the URLs of those Websites were written on small strips of card that the students selected. When the students located pictures in the Websites that they thought would be useful for the class' topic of space, they printed them on a colour laser printer. In that situation, Internet access was used as an information resource in the same way that books and other resources in the classroom were also being used. This Grade 1/2 class has also used email extensively and students have used their email address to communicate with parents during the day.

Similarly, in Case 4, students are not only learners but also teachers. With multi-age classes made up of students with differing experiences in using technology, there are opportunities for students to teach their peers and even their teachers. In the Micro Worlds class, students often asked advice from others in the class. In one Grade 2/3 class students were involved in a variety of mathematics activities. One group of students selected a theme ('camping') and drew a scene on the computer depicting this with shapes such as a triangle for a tent. The shapes were then labelled. Another group used plasticine and straws to make 2D shapes such as a square, then turn it into a 3D shape. Some went further and made a house. Students experienced a range of technology through the curriculum programme. In this way they developed a good understanding of what technology can do for them. Students were also engaged in using a range of software creatively by applying their knowledge to complete authentic tasks. Outcomes are

achieved over the two-year cycle of eight units of study. Through the many varied activities and the two-year cycle, students are able to demonstrate the achievement of the outcomes in a variety of ways. Students are involved in monitoring their own progress so they are aware of what they need to find out or learn.

Cognitive processing objectives

When the pattern of cognitive processing objectives is examined it becomes evident that few of the processing objectives involve remembering. There is a strong emphasis on understanding and on creating. Students reported that they were fascinated to find out more about Chinese culture, they liked working in groups and being able to pool their discoveries. The students thought it was a quick way to get a lot of information and to get other people's opinions besides their own. They also liked posing questions to real people such as the Chinese Curriculum Consultant and the authors. They felt that this was an excellent way of getting answers to questions that interested them. The students felt that they had learnt more in two weeks than a whole term of history.

In Case 4, students produce each term a quality product that illustrates what they've learnt from the unit of study that had been undertaken. The Grade 4/5 students studied the unit 'well-being' in the term previous to the project team's visit. The quality product that celebrated their learning was a short video clip that illustrated an aspect of health and safety. It was produced using HyperStudio and QuickTime. Students wrote their own skits, made clay figurines and objects to illustrate them, and then took still photos depicting important stages of their messages. QuickTime was used to produce animations, and music and voiceovers were added. A presentation and awards night (the 'Clogies') was held to celebrate the learning the students had engaged in over the term. Groups of students presented their movies (clay animations) and talked about it to a large audience of parents and siblings.

Discussion

Australian education has identified as priority areas for information technology: a greater understanding of the interdependence of conditions which facilitate success in improving both student and teacher learning outcomes with the use of ICT; the identification and operationalisation of the role of school education in the context of a knowledge society; the need for equity to both access and effective use of ICT; the need to bridge the gap between the potential of ICT and its actual implementation in the classroom; and national monitoring of teacher and student competencies, resources and learning outcomes.

Although progress in relation to these objectives has been made, much still needs to be done in supporting teachers and school systems in transforming the learning environment of the classroom into one that fully captures the potential of using ICT to improve student learning.

One aspect of the use of ICT in schools and classrooms focuses on competencies in using the technologies. Developing those competencies is important and many of the schools that were studied in this investigation recognised that importance. In Australia, several states have implemented assessment programmes to monitor the ICT competencies of students. The OECD Programme for International Student Assessment (PISA) indicates that Australian students are above the international average for comfort, ability, usage and experience with computers (OECD, 2001). However, most of the schools included in this set of case studies were also concerned with using ICT to develop student knowledge and cognitive processing capacities. Several of the schools were in school systems that had established methods for improving the ICT skills of teachers so that they could work more effectively with their students to use ICT to develop broader intellectual skills.

Embedding ICT into classroom practice requires teachers to work in quite different ways than previously, and expects students to learn new things in quite different ways. Much literature refers to the use of ICT to foster students' higher order thinking skills, even though these skills may be conceptualised in a variety of ways. Several of the case study schools in this report describe using learning taxonomies and schema as important aids to planning for higher order outcomes. For instance, Grange School and Toorak College developed rubrics to assess student outcomes and those rubrics specified higher order skills such as problem solving. The Quality Product that marks the completion of a student's unit of work at Woodcrest College has an underlying rubric.

In these schools it is accepted that technological literacy is not necessarily a goal in itself but a means to improving learning outcomes. The development of analytical and higher order cognitive skills has always been viewed as empowering thinking and problem-solving ability. Now, it is recognised that ICT can facilitate the programmes and approaches that develop these abilities. However, the pursuit of this goal is dependent not only on the technology available but also on the capacity of teachers to implement programmes that are challenging, diverse and actively engage students. It is important to attend to other aspects of learning environments rather than assume that the introduction of technologies alone will result in changes. These case studies show how schools in different settings can establish appropriate technology infrastructure and develop teaching practices that enhance technology skills and a range of broader skills.

Pouring resources into IT infrastructure does not necessarily reflect the actual implementation of the technology in schools. Fluck (2001, p 156) describes the phases in the uptake and use of computers in education: providing computers, establishment of frameworks for student and teacher competencies for using ICT across the curriculum, content changes in all curriculum areas and flexible school learning through the use of ICT. Fluck argues that although many are focused on the second phase there are examples of the third 'where the computer changes the way in which education is conducted'.

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Australian 14-year-olds' civic knowledge and attitudes, and how teachers and schools might improve them

Suzanne Mellor

Suzanne Mellor has been a teacher in secondary and post-compulsory classrooms and has worked in teacher training institutions over many years. She was Chief Examiner in Australian History in Victoria for many years, coordinating curriculum writing for accrediting bodies and devising a wide range of professional development activities for teachers. She has published textbooks and courses through accrediting bodies, commercial publishing houses and subject and teacher organisations. She has been a Research Fellow at ACER since 1989, conducting and contributing to a range of projects in policy and evaluation and reports published by ACER. In 2002 she was joint researcher for the World Bank project, Promoting Social Tolerance and Cohesion through Education, in the South Pacific. Three reports and an educational framework were produced for this study.

Suzanne has undertaken substantial work in citizenship education for ACER.

As ACER's Project Director of Phase 2 of the Australian component of the IEA Civic Education Study she managed the survey of schools, teachers and students across Australia and wrote the national report, released by the Commonwealth government in March 2002. She is currently conducting the independent evaluation of the Discovering Democracy professional development programme.

The Australian context for the IEA Civic Education Study

The IEA Civic Education Study took place in Australia from 1996 to 2002 against a background of national questioning of civic institutions. At its commencement there was active debate among citizens and political leaders concerning Australia's constitution and British connection. The debate surrounding the republic referendum and preparations to celebrate the centenary of federation in 2001 was part of the political context as civic education gained a profile in the school curriculum in the late 1990s.

In Australia at the time of the study, civic education was only just becoming a policy priority for government. Successive governments in the 1990s had provided powerful impetus for the introduction of formal civic education in schools. In 1997 the federal government initiated a large-scale curriculum development exercise entitled 'Discovering Democracy' that resulted in resources being developed for upper primary and lower secondary students for use in programmes of civic education. Every school in Australia was provided with the first of these materials late in the decade.

As a complementary response, each government at state/territory level made civic education a non-compulsory priority in the school curriculum by the end of the decade. At the school level, Australian students had probably been exposed to civic issues and ideas, but neither in a systematic way, nor consistently across states or systems. The IEA Civic Education Study test and survey instruments were administered late in 1999, at which time the new Discovering Democracy curriculum materials initiative would have had little effect on student learning or staff professional development.

It was, however, an ideal time to find out what young Australians knew and valued about democracy and what their attitudes were to a range of issues that affect democracy. Government and the community regarded data about such matters as worth having. The Discovering Democracy materials had previously had little chance to impact on students' knowledge acquisition or teachers' practice, so the study took on a benchmarking role.

Given the slightness of the formal Australian civic learning context, it can be reasonably assumed that family, peers, informal school activities, the media and students' everyday activities in the community would have been at least as important in influencing students' civic understandings and attitudes as their in-class school experiences. This view of the sources of significant exposure is supported by the time estimated by principals to have been spent on civics in their schools. Approximately 70 per cent of principals indicated that students spent less than one hour a week on civics, 20 per cent of principals said their students spent between one to two hours, and 10 per cent put the figure as high as three to four hours. However the definitions of 'civic education' they used were very broad, and possibly problematic.

The conduct of the IEA Civic Education Study in Australia

The International Association for the Evaluation of Educational Achievement (IEA) carried out the study in two phases. In Phase 1 (1995–99), national researchers conducted qualitative case studies that examined the contexts and meaning of civic education in 24 countries.¹ In Phase 2 (1999), nationally representative samples of nearly 90,000 14-year-olds in

¹Torney-Purta, J., Schwille, J. & Amadeo, J. (1999). *Civic Education Across Countries: Twenty-four National Case Studies from the IEA Civic Education Project*. IEA and National Council for the Social Studies, Amsterdam and Washington.

28 countries were surveyed. The findings from the international study were reported in March 2001.² The Australian national report analysing and interpreting the Australian data collected during the study was released in March 2002.³

A two-stage stratified cluster design for sampling was employed. At the first stage, schools were sampled using a probability proportional to size. One hundred and forty-two Australian schools took part (a participation rate of 94 per cent). The sample structure ensured proportional representation of government, Catholic and independent schools, provided a good estimate for Australia overall, but did not enable comparisons between states.

The second stage of the sampling process consisted of selecting one classroom per school from the target grade. The chosen class was not to be tracked by ability and was, where possible, to be in a civic-related subject (eg history or social studies). The Australian cohort of Year 9 students was 3,331 (a participation rate of 92 per cent).

The 352 respondents to the teachers' questionnaire (three requested from each of the 142 participating schools) were teachers of English, SOSE or were curriculum coordinators. Principals from 120 schools responded to the school questionnaire.

The IEA concept of civic knowledge and attitudes

Underpinning the IEA Civic Education Study was the concept of civic education as a complex enterprise involving a variety of cognitive, conceptual and attitudinal strands, each of which is important and open to independent evaluation. The model of civic education particularly addresses the issue of how students gain civic knowledge and develop civic attitudes, and it foregrounds active citizenship.

The proposed topics for examination were based on the three broad domains established early in the project as representing the core knowledge base of civic education. These were:

- democracy / citizenship;
- national identity / international relations; and
- social cohesion / diversity.

So there were items and questions on content knowledge, skills in interpretation, the understanding of concepts and attitudes, and expected actions.

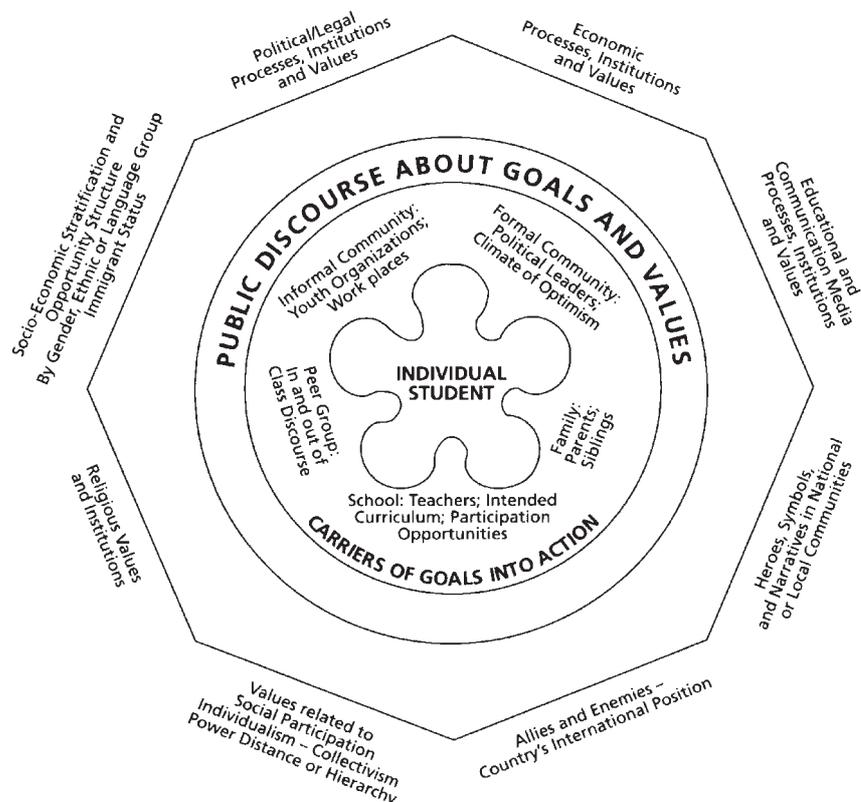


Figure 1 Model for IEA Civic Education

²Torney-Purta, J., Lehmann, R., Oswald, H. & Schulz, W. (2001). *Citizenship and Education in Twenty-eight Countries: Civic Knowledge and Engagement at Age Fourteen*, IEA, Amsterdam.
³Mellor, S., Kennedy, K. & Greenwood, L. (2002). *Citizenship and Democracy: Students' Knowledge and Beliefs: Australian Fourteen Year Olds and the IEA Civic Education Study*. [Online] www.dest.gov.au/schools/Publications/2001/iea/AustCivicReport.pdf www.acer.edu.au/mediacentre/AustCivicReport_2002.pdf

Australian students' civic knowledge and attitudes in an international context

Ten countries had scores measuring total civic knowledge that were significantly above the international mean. The United States was one of those countries. Eight countries were significantly below the international mean. Ten countries, positioned in between these two groups, had means that did not vary significantly from the international mean. Australia and England were two of those 'average' countries.

On the 11 attitudinal scales, Australia achieved an above average rate of support on only two, a below-average response rate on four, and an average on five of the scales. The devil is in the detail of course, and the illumination we seek from involvement in international studies derives from how comparisons can be drawn, on which scales and in which items there is significant agreement or disagreement. One also must ask of these comparisons what we may learn from them that could inform policy or practice in future planning or curriculum.

Some general trends in influences identified in the international data

The international data indicate that civic knowledge is not gender-based, though there were substantial gender differences on some of the attitudinal scales and differences between specific countries on specific scales.

Like their international peers, only a little more than half of Australian students (55 per cent) said they had learnt in school about the 'importance of voting in national elections'.

In the large majority of countries, the more books students reported in the home the better they performed on the civic knowledge test. Australian students' responses exemplified this pattern.

The television news is the preferred source of information for 80 per cent of Australian students (the international rate is 86 per cent). Australia is one of the countries where the frequency of watching news is associated with higher civic knowledge, with a greater effect than the international average. Australian students also read newspapers and listened to the radio news more often than most international cohorts.

Schools that model democratic practice are the most effective in promoting civic knowledge and engagement in their students. Students who have experienced engagement in voluntary or school organisation participation are more likely to do well in

the acquisition of civic knowledge and to have positive civic attitudes. Such was the pattern of the Australian responses in the study. This finding is the most broad-ranging in its effect, because it impacts on civic learning regardless of curriculum provision.

The value of comparing student response patterns across like-countries

Twenty-eight countries of varying political development participated in the IEA Civic Education Study. They were all democracies, but they had adopted this model of governance in very different circumstances. The purposes their citizenry viewed as the legitimate goals of government and the learning outcomes they sought for their students in relation to civic education were wide-ranging. Thus the value of comparing the responses of the student cohort of ones' own country with such a range does not immediately present itself.

But the experience of engaging with such a range of views as to what is important for students who live in a democracy is valuable. The student questionnaire, like the other testing instruments, was designed by experts from all participating countries and by members of the IEA International Steering Committee. The construction of the items for the test and survey was a long, engaging and heavily consultative process that exemplified a passionate commitment to democratic values. The resultant items are ones that will stimulate discussion of the preferred learning outcomes in any society in which such matters are considered important.

The provision of civic education in Australia is closely comparable to some of the other 27 countries that participated in the IEA Civic Education Study, but in sharp contrast with others. At the time of testing, the case of civic education provision in England was very close to that of Australia, although England has since introduced a civic education program that requires (from 2004) the reporting of learning outcomes at several key stages of schooling. The situation in the United States was unlike that in Australia, in that formal civic education has a long history in primary and secondary levels, and all students would have experienced a range of civic curricula by age 14. Since England and the United States are two of the few other country participants in the study that have released their national reports, some comparisons with them are possible.

There are other reasons why comparisons of student civic understandings with those from England and the United States are illuminating to the Australian data. All three countries are long-standing representative democracies, with developed economies and value

systems. There is a shared history, and each draws on similar precepts as to how government and non-government institutions relate to each other and to the populace. The education systems of each country have significant similarities. There are differences too, and some of these are illustrated by the student responses to some of the items in the IEA Civic Education Study.

Australian students' total civic knowledge

The 'total civic knowledge' scale was composed of two sub-scales: content knowledge (made up of 25 items) and interpretative skills (13 items). You will recall that students in the United States were in the above-average group on the total civic knowledge scale, and Australia and England were in the average group.

However, if one regards the scores on the two sub-scales, an interesting comparative pattern emerges. We see the three countries have retained their position relative to each other and to the international cohort, but at two distinctly different levels. The United States' students gained a mean of 102 on the content knowledge items, Australia 99 and England 96. (On all these scales the international mean was set at 100.) But on the interpretative skills items the relative scores were, respectively, 114, 107 and 105. So the relative strength of the students' knowledge is similar on both sub-scales, but dissimilar to the rest of the international cohort. The items in the two sub-scales test different matters, and the students demonstrated a differential learning.

The bulk of the civic knowledge items have a regular multiple-choice structure. A proposition is put, four potential responses to it are offered and a choice is to be made. These are the content knowledge items. The interpretative items have a variety of formats. They all involve a level of 'reading', of text or picture, followed by the question, again four potential responses to it are offered and a choice is to be made. A sample 'interpretative skills' item follows:

Identify which party issued the leaflet

We citizens have had enough!

A vote for the Silver Party means a vote for higher taxes.

It means an end to economic growth and a waste of our nation's resources.

Vote instead for economic growth and free enterprise.

Vote for more money left in everyone's wallet!

Let's not waste another four years!

VOTE FOR THE GOLD PARTY

This is a political leaflet which has probably been issued by...

	Total %	Female %	Male %
the Silver Party.	6	5	8
a party or group in opposition to the Silver Party.*	79	83	74
a group that tries to be sure elections are fair.	8	6	11
the Silver Party and the Gold Party together.	7	6	7

The above response rates are those of the Australian students. The item references the importance of elections and of being able to interpret campaign materials before deciding on voting intentions. The response options allude to issues such as fairness in elections and the notion of coalitions, and requires the skill of identifying which voice is that of the author party. Students had to read the campaign leaflet and then decide which of the two parties mentioned had authored it. Australian students found this a relatively easy task, particularly the female students. The Australian mean (79 per cent) was lower than that of the United States (83 per cent) and above that of England (75 per cent).

The international picture was quite different. The response range was from 40 to 83 per cent, with a mean of just 65 per cent. The skills are based on textual comprehension, requiring a close reading for consistency of thought in the argument in the leaflet. These are the kinds of skills students in the three countries of comparison acquire in topic analysis and discussion, a pedagogic style that operates in many of their classes. Eight other countries (of the 28 surveyed) achieved a mean of 75 per cent on this item, so adoption of this pedagogy may be a factor in their success. But as most of them also did better on the civic knowledge sub-scale than the sub-cohort of three, the strength of their civic knowledge may have been the dominant explicator. Of course, decoding the four response options also requires some civic knowledge, as well as interpretative skills.

As a result of their relatively greater than average skill in interpretation and all that implies, the students of Australia, England and the United States were able to gain a better position relative to the whole cohort than they would have been able to achieve without them. It also indicates that this pedagogy is one suited to a range of content, and has positive effects on a range of learning outcomes. The study's designers did not anticipate the power of this factor in learning. It is just the kind of research outcome which international studies can gift to researchers.

Most of the civic knowledge items draw from Domain 1 and deal with aspects of democracy. Due to the secure nature of the items in the civic knowledge test, detailed description of the analysis, nationally and thus

between nations, is constrained. However, through the sample items one can observe some comparisons.

The civic knowledge items Australian students had the most difficulty with were those that dealt with the forms and purposes of democracy. Only half of the Australian students demonstrated clarity about the theoretical precepts of democratic models and structures, including: the role of criticism in a democracy; civil rights; the function of periodic elections; the content (and by implication the purpose of) a constitution; the legitimate media influence in a democracy; and the stages a government moving from dictatorship to democracy would need to undertake.

Sixty per cent of Australian students successfully inferred the consequences to democracy of a large publisher buying up many of a nation's newspapers, and 59 per cent in the United States and only 49 per cent from England (with the international average at 57 per cent).

In each of the three countries in the sub-cohort, 78 to 79 per cent of the students identified that having many organisations for people to join is important to democracy because it provides many opportunities to express different points of view (the international average is 70 per cent).

Students in all countries had difficulty recognising the distinguishing characteristics of a non-democratic government. The international mean was 53 per cent, as was that of the United States. Australians students achieved 51 per cent and the English 45 per cent. It is clear that this is a crunch concept, and the students have relatively similar difficulty in recognising the distinguishing characteristics. Key words are not grasped in their full context, even in the countries where formal civic courses might have been expected to create such knowledge.

Like their international peers, Australian students do not have a strong grasp of the impact of economic issues in the functioning of a democratic system. They do not have a clear sense of where the inherent tensions between democratic ideals and economic exigencies lie. Only a third could correctly identify the role of trade unions in a modern economy, the key characteristics of a market economy, or a range of issues associated with multinationals and globalisation.

The main conclusion that can be drawn from the strength of the Australian responses on the total civic knowledge scale, vis-à-vis the international responses, is that there are significant differences between them, and there are even smaller differences (of course!) between those countries that share the average mean. It is not unreasonable to hypothesise that the differences between Australia, the United States and England on the total civic knowledge scale result from the level of civic education provision in those countries. It appears that students do learn civic-related knowledge in

schools and that formal provision of civic education in schools can make a difference. Students don't acquire their civic knowledge solely from the society in which they live. Some of the similarities in the civic knowledge scores from the sub-cohort appear to indicate that similar pedagogic styles exist in classrooms across the three countries, and that this too makes a difference to civic learning outcomes.

Australian students' civic engagement

The first group of the attitudinal scales, called the 'civic engagement dimension', consisted of four scales. These scales reference active participation. Australian students' scores are significantly below the international mean on three of the four scales that make up the civic engagement dimension. It appears Australian students do not endorse action by citizens. England's results were the same as Australia's. In comparison, students in the United States achieved an above average mean in the first three and average on the fourth.

On the 'conventional citizenship' scale the Australian students showed they believe a good citizen votes and shows respect for government representatives. But, like their English peers, and unlike those from the United States, they regard knowing the country's history and following political issues in the press as relatively unimportant. All three cohorts register the least interest in the citizenship activity of engaging in political discussion, but the differences between the three is substantial. Only one third of students from England and Australia think it important, compared to nearly two-thirds of US students.

On the 'social movement citizenship' scale, the Australian students' responses indicate a less than enthusiastic endorsement, but 80 per cent did believe in the importance of citizens participating in 'activities to benefit people in the community'. Three quarters of the Australian students think protecting the environment is important, and two thirds support the importance of promoting human rights. Only just over half of the Australian students think it important to participate in peaceful protest against a law they believe to be unjust. In comparison, students from the United States have a 15–20 per cent higher support rate. The English support is rate lower, across all the items, by about 10 per cent.

The Australian mean for the 'expected participation in political activities' scale was also significantly below the international mean. Given that voting is compulsory in Australia, students' expectation that 86 per cent of them will vote is less significant than for those countries where it is optional. Eighty-nine per cent do not expect to join a political party, 76 per cent do not expect to write letters to newspapers about social or political concerns, and 87 per cent do not expect to be a candidate for a

local or city office. Two thirds of Australian students reported that they expect to collect money for a social cause or charity. Only 40 per cent said they would be prepared to join a non-violent protest march. Students in the United States are twice as likely to join a political party than either the Australian or English students.

On the 'confidence in participating at school' scale, the Australian mean is 'average'. Australian students appear to have a more positive view of what can be achieved by groups of students in schools than they have of what adults can achieve by active participation in the political process. Participation in a school council or parliament is positively related to civic knowledge for Australian students, indeed even more so than for the international students. However, only one third of them has participated in a school council or parliament. The United States details of results to this scale are not published (they were in the average band), and the support rates from the students in England are about 10 per cent less than in Australia.

Another scale that I believe draws on the same aspects of civic and citizenship learning as the above four scales is the 'open classroom climates' scale. Students from Australia and England registered an average mean and those in the US expressed an above average experience of the open classroom. Students in eleven of the 28 countries had a negative response, claiming they rarely discuss things in class. Thus, the pedagogic experience is again linked with learning outcomes. Two thirds say they are often encouraged to voice their opinion in class. Nevertheless, similar to their international peers, a quarter of the Australian students says this happens rarely or never.

About three-quarters of the Australian students had generally positive responses to the open classroom items, with the response rating from England being about two thirds. Those from the United States were consistently in the high 70 per cent to low 80 per cent range. Once again the pedagogy and the content are inter-twined in providing positive learning outcomes. In addition, the three cohorts share a much lower support for one item, that which asked students whether 'teachers encourage us to discuss political or social issues about which people have different opinions'. In each country the support rate for this item went down by almost 20 per cent. Students in each country are telling us that controversial issues are not encouraged as subjects for discussion; that teachers stay with safe topics.

All three national patterns on the items on these five scales indicate that more positive civic attitudes about engagement co-exist with greater civic knowledge. It may be that students are demonstrating society-wide attitudes here, though the levels of engagement, by voting and other measures, would not suggest that

such differences exist across the three countries. These results indicate that formal provision of civic education makes a difference to civic attitudes.

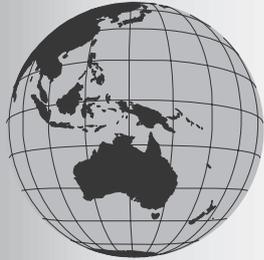
Conclusions: what we learn from these comparative data

The IEA Civic Education Study demonstrated the relative civic knowledge of students in 28 countries. It also illustrated the civic attitudes of the students. By virtue of the combination of all these scales we have a set of understandings of both the learning outcomes and also some indication of how they can be acquired. The study reminds us also of the pervasive nature of civic learning. Civic knowledge does, after all, relate to the engagement of the individual with significant groups in that individual's life, so it is not surprising that it generates questions about how and where one learns, not just what one learns. The contested nature of all these civic and citizenship domains is part of what schools need to unpack when planning their classroom and non-classroom civic curricula.

The most important finding of the study is that schools that model democratic practice are the most effective in promoting civic knowledge and higher levels of engagement in their students. The inter-country comparisons lend some support to this proposition. Providing students with a climate of engagement in classrooms is important to civic learning, but insufficient to generate civic learning or positive civic attitudes in the majority. As other studies have indicated⁴, real issues, ones that concern students, must be available as serious areas of academic work and assessment. The IEA international (and Australian) path analyses show that students who participate in school councils do better than those who do not have that experience. It is not by chance that the students who know the most (within and between countries) are those who also care about participating. Such students are the most positive about their capacity to make a difference.

Schools need to provide all students with opportunities to actively participate, in classrooms and in school governance. Teachers need to model good citizenship and schools need to provide models of, and practice in, good democratic decision-making. Formal civic education will then be seen to be more relevant to students. Their belief in the value of their democratic institutions will rise as their knowledge increases. The study and the sub-cohort comparisons demonstrate this. If citizens of the future are to be fully engaged in the democratic process they must have a solid understanding of the democratic institutions that underpin that process. Schools can both teach and model such learning. We cannot afford, as a democratic society, for schools to fail to encourage such learning outcomes.

⁴Mellor, S (1998) *What's the Point? Political Attitudes of Victorian Year 11 Students*, Research Monograph 53, ACER, Melbourne



3. Poster presentations

Poster Presentations

Prue Anderson and Ray Peck

Australian Council for Educational Research
Extending the PISA reading literacy and mathematical literacy described proficiency scales

Diane Ballantyne

ACT Department of Education, Youth and Family Services
An Inclusive Approach to the Assessment and Reporting of Student Information and Communication Technology (ICT) Achievement

Kate Dibben

education.au limited
The ICT Research website

Kate Dibben

education.au limited
The ICT Leading Practice for Schools and Leadership website

Martin Koomen

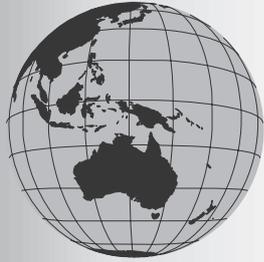
Australian Council for Educational Research
The PISA website: a research tool for practitioners

Jennifer Michalski

Pymble Ladies College, NSW
Teaching and Learning in a Technological Environment over 10 Years: Student, staff and parent responses to change

Will Morony

Australian Association of Mathematics Teachers
Development of Professional Teaching Standards in Mathematics, and Processes for Their Use



3. Conference program

SUNDAY 13 OCTOBER

6.00 – 7.30

Opening reception

MONDAY 14 OCTOBER

9.00

Conference opening

The Hon. John Watkins, Minister for Education and Training, NSW

Geoff Masters, CEO, ACER

9.30

Plenary address

Raising the bar and reducing the failures: A possible dream

Barry McGaw, Director, OECD Education Directorate, Paris

Respondent: Susan Pascoe, Victorian Curriculum and Assessment Authority

Chair: Geoff Masters, CEO, ACER

11.00

Morning tea

11.30

Concurrent Sessions 1

Session A: Retrieving information, Interpreting, Reflecting, and then...Using the results of PISA Reading Literacy

Juliette Mendelovits, ACER

Chair: Kerry-Anne Hoad, ACER

Session B: PISA from Australia's perspective

Jan Lokan, ACER

Chair: Margaret Forster, ACER

Session C: Why do education systems differ in educational outcomes?

John Keeves, Flinders University

Chair: Marion Meiers, ACER

12.30

Panel discussion

Chair: Marion Meiers and Kerry-Anne Hoad, ACER

1.00

Lunch

with Poster display

2.00

Plenary Session: Panel discussion

What can we learn from international achievement studies? What have we learnt? What are we doing?

Panelists: Wendy Whitham, DEST, Susan Dennett, DET Victoria, Gordon Stanley, Board of Studies, NSW

Chair: Margaret Forster, ACER

3.30

Afternoon tea

4.00

Concurrent Sessions 2

Session D: PISA Science: Pointing the way forward for school science

Peter Fensham, Monash University

Chair: Jan Lokan, ACER

Session E: Messages for minority groups in Australia from international studies

Paul Hughes, Flinders University and Lisa Greenwood & Tracey Frigo, ACER

Chair: Juliette Mendelovits, ACER

Session F: Information and Communication

Technologies in Classrooms: Perspectives from an International Study

John Ainley, Diana Banks and Marianne Fleming, ACER

Chair: Kerry-Anne Hoad, ACER

5.00

Close of discussion

7.00

Conference Dinner

Speaker: Jessie Borthwick, Group Manager, Research Analysis and Evaluation Group, Department of Education, Science and Training, Canberra

TUESDAY 15 OCTOBER

9.00

Plenary address

The IEA International Civics Study

Judith Torney-Purta, University of Maryland, USA

Respondent: John Ainley, ACER

Chair: Peter McGuckian, ACER

10.30

Morning tea

11.00

Plenary session

Implications from the Initial Findings of the TIMSS-R Video Study of Mathematics Teaching

James Hiebert, University of Delaware and Hilary

Hollingsworth, ACER and LessonLab. Inc. USA

Chair: Jan Lokan, ACER

12.30

Lunch

with Poster display

1.30

Concurrent Sessions 3

Session G: PISA Mathematics Literacy

Jan de Lange, University of Utrecht, The Netherlands

Chair: Margaret Forster, ACER

Session H: Understanding mathematics classrooms internationally: The Learner's Perspective Study

David Clarke, University of Melbourne

Chair: Marion Meiers, ACER

Session I: Australian fourteen year olds' CMC knowledge and attitudes, and how teachers and schools might improve them

Suzanne Mellor, ACER

Chair: Kerry-Anne Hoad, ACER

2.45

Overview:

Lessons that can be best learned from international comparisons

Barry McGaw, OECD Paris

3.15

Closing remarks

Geoff Masters, CEO, ACER

3.30

Close of conference