The AHELO experience – implementation, outcomes and learning from an Australian perspective

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Introduction

This paper provides background, implementation processes and outcomes relating to Australia's participation in the Organisation for Economic Cooperation and Development's (OECD) Assessment of Higher Education Learning Outcomes (AHELO) Feasibility Study. The Federal Department of Innovation, Industry, Science, Research and Tertiary Education (DIISRTE) funded the Australian participation in this project via direct contribution to the OECD, and through funding of a National Centre to implement the study in Australian universities.

The AHELO Feasibility Study was a major OECD project. Its objective was to determine a robust approach to measuring learning outcomes in ways that are valid across cultures and languages, and across the diversity of institutional settings and missions. Further detail including aims and final reports relating to the project can be found at http://www.oecd.org/edu/ahelo.

The AHELO Feasibility Study involved the testing of students in three strands – Generic skills, Economics and Civil Engineering. For the Feasibility Study, Australia participated in the Civil Engineering strand and it is participation in this strand that is the focus of this chapter. In addition to these assessments, contextual dimension questionnaires were deployed to students, faculty and institutional staff at all participating institutions.

The implementation of the Feasibility was split into two phases. Phase One was undertaken in 2011 and involved engaging institutions, coordinating focus groups in participating universities; undertaking an academic review of draft assessment instruments; marking of student responses; and the collation and communication of feedback from institutions and students. Phase Two took place in 2012 and involved re-recruiting universities, sampling of students and staff, technical assistance in preparation for AHELO assessments, administration of the assessments and questionnaires, scoring of test scripts and reporting of results.

This paper offers insight into the processes, activities, outcomes and dissemination of results from the AHELO Feasibility Study in Australia with particular emphasis on the student-related data. It begins by providing a brief background about the concept of AHELO and the practicalities relating to the project. It then examines the process of implementing the study in Australia, beginning with Phase One and the

collection of feedback relating to the draft instruments. The implementation of the AHELO assessment (Phase Two) is then detailed, alongside some insight into participation numbers and some notable but broad outcomes reported. The final section of the paper discusses overall outcomes of the Feasibility Study from an Australian perspective and considers some possibilities for alternative approaches to dissemination and reporting.

AHELO Background

This section provides a background to the AHELO project. It was jointly prepared with members of the AHELO Consortium and provides insight into the aims of the study. It is included here to provide an overall perspective for framing the work detailed in this paper. The overall aims and ambitions of the Feasibility Study are important and are sometimes lost in the detailed discussions of process in this work, so this section offers the chance for reflecting on the 'bigger picture' of what was trying to be achieved.

Is it possible to undertake an international assessment of final-year students' capacity to use, apply and act on the knowledge and reasoning they have gained from their degrees? Is it possible to assess these outcomes in an efficient and internationally comparable way? Can policymakers, institutional leaders, faculty and students be convinced that the assessment of higher education learning outcomes is an essential checkpoint in the educational process? These questions lie at the core of the OECD's AHELO Feasibility Study.

AHELO involves the development and validation of assessments in three core areas – Generic Skills, Economics and Civil Engineering, as well as the development of contextual instruments to aid with the interpretation of assessment data. The assessments are targeted at students in the final year of bachelor degrees and aim to assess their capacity to apply their skills and knowledge to real-world problems. AHELO is an ambitious project in that it aims to develop new methodologies and technical standards for the assessment of higher education learning outcomes. It is taking place on a global scale, with 17 countries participating in the development and validation of assessments, and engagement from experts, institutions, governments, and key higher education bodies from around the world. The project is run by a consortium of international organisations, led by the Australian Council for Educational Research.

AHELO responds to a critical information gap. Efforts to improve the quality of teaching and to enhance students' learning outcomes are stymied by the absence of reliable information which enables comparative judgments to be made about the capabilities of students in different institutions and in different countries, or about the quality of teaching. In the absence of such data on core higher education activities of learning and teaching, the standing of a higher education institution is based largely on reputation and research performance. AHELO's objective is to create a richer source of information through designing and testing measures which give due weight to teaching practices and learning outcomes.

The AHELO assessments were developed through the collaboration of experts from around the world and subsequently translated and adapted for use in all participating countries. Validation of the assessments with students in participating countries was completed in 2011. The assessments that were developed through for AHELO were implemented across 17 countries in 2012.

The study has had an impact on the way in which discussions about higher education and assessment are carried out, suggesting that AHELO has the potential to reshape the higher education landscape in important ways. First, discussions among some stakeholders appear to have moved on from whether learning outcomes *should be* measured to *how they can be* measured. At the same time, the engagement of national systems and institutions (both within and outside the OECD) has increased significantly throughout the life of the Feasibility Study. Taken together, these indicate the existence of a desire for data on the quality of teaching and learning, both to inform improvements and also to demonstrate quality.

Facilitating AHELO in Australia

Australia's participation in AHELO was funded and supported by the Federal Government. The Government facilitated the organisation of a National Centre which included a National Project Manager (NPM), some basic support and stipend for travel. The NPM in Australia was essentially responsible for implementing all aspects of the AHELO Feasibility Study, under the direction of the AHELO Consortium and the OECD Secretariat for the study. Many of the key activities of the NPM and National Centre are detailed in the sections of the paper dealing with activities in Phase One and Two. One aspect of the work not covered as much in these latter sections is the element of communication required through the duration of the project. This aspect is discussed briefly here.

The NPM maintained close and frequent communication with the Federal Government through the Department of Innovation, Industry, Science, Research and Tertiary Education (DIISRTE) throughout the Feasibility Study, providing monthly progress reports during the busy times in the project and having regular teleconferences. The progress reports and discussions helped keep the Department aware of the day-to-day activities of the NPM as well as providing insight into the extent to which the project was being embraced by universities, university leaders, academics and students.

The National Centre also played a critical role in developing relationships and communication with participating institutions. Contact and collaboration with institutions was maintained during the study through teleconferences, a symposium, site visits and email. The key institutional relationship maintained by the NPM was with each Institution Coordinator, who was in charge of activities within their university. Building personal connections with these people was an important and highly valuable facet of the project.

Another key role of the NPM that is not explored as much in the other sections of this paper is that this role provided a channel through which Australian national interests are represented in the implementation of the AHELO Feasibility Study. The Australian Government were interested in ensuring that there was important Australian input into the development and adaptation of relevant test instruments and in the processes and procedures used in data collection.

Implementation of AHELO

This section of the paper provides an overview of the AHELO Feasibility Study as a whole from the perspective of the in-country implementation of the study. Implementation within countries and institutions participating in the Feasibility Study was carried out in two phases. Phase One involved qualitative testing of items through surveys and focus groups and providing feedback to the OECD and AHELO Consortium relating to the instruments constructed for the study. Phase Two involved the implementation of the AHELO assessments in universities and with students under test conditions as well as the completion of staff and institution-level surveys.

During Phase One of the Feasibility Study, qualitative testing of the draft assessments was undertaken in a number of countries. During focus groups and cognitive labs, students provided feedback on the assessments, while a number of senior academics in the area of civil engineering were asked to provide comment and review of the draft AHELO assessments. In summary, the key facets of Phase One were:

- *University engagement and recruitment* – securing the interest and participation of universities.
- *Support for participating universities* – providing detailed information to universities about participation, including, a Manual, discussions and training for Institutional Coordinator and ongoing contact and support.
- *Implementation of focus groups* – carried out at each university and facilitated by the Institutional Coordinator. Involved students taking a sample of the draft assessment and providing feedback through a survey and focus group.
- *Academic Review of AHELO instruments* – by experts in civil engineering education.
- *Collation of test results and feedback from students and academics* – organised by NPM and included marking of test papers, collation and coding of surveys and construction of a national database.
- *Providing feedback on test instruments* – involving analysis of responses and collation of key points for feedback to the AHELO Consortium.

Phase One activities in Australia were undertaken in 2011 and involved ten universities (further detail is contained in the 'outcomes' section of the paper).

Phase Two involved the full implementation of the AHELO assessment in universities to cohorts of students online under test conditions. It also involved the collection of survey data from academic staff and Institution Coordinators.

In summary, Phase Two involved the following activities for Australian participation:

- *Institutional recruitment* – re-securing the interest and participation of universities.
- *Development of manuals for institutions* – to assist in implementation of the online testing and in recruiting of students.
- *Institutional Coordinator training and support* – to ensure all participating institutions were familiar with the AHELO test system and AHELO test administration protocol.
- *Institutional sampling* – collecting population data on eligible students and staff members in participating institutions.
- *Setting up test computers* – providing advice and information on establishing secure online profiles for testing centres.
- *Test administration* – involving the implementation of the AHELO tests to students in participating universities and monitoring the administrations to confirm test sessions were run according to protocol.
- *Survey administration* – sending the staff and institutional survey to identified population and following up to secure maximum response numbers.
- *Scoring of assessment responses* – involving recruitment of a Lead Scorer, training in scoring and facilitating scoring among a group of experts.
- *Supporting data processing and international analyses* – ensuring adherence to AHELO protocol and maximising international comparability of data.
- *Attend international training and dissemination meetings* – maximising the value of lessons drawn in the Australian context as well as benefitting from insights in other countries.

Phase Two was conducted in Australia during 2012, with testing being undertaken between March and May in eight universities (details in 'outcomes' section).

Recruiting Institutions

Based on requests from the OECD and AHELO Consortium, Australia aimed to have ten universities participate in the Feasibility Study. As such, early in 2011, the Vice-Chancellor and Dean of Engineering at ten Australian universities were written to and invited to participate. All ten invited institutions agreed to be part of at least Phase One of the study.

Selection of universities involved liaison between the NPM, the Department (DIISRTE) the Australian Council of Engineering Deans (ACED). Universities were selected on the following basis (in order of selection priority):

1. They had actively shown prior interest in AHELO (through informal discussion with the Government).

2. They had previously provided contact details for an Institutional Coordinator to DEEWR.
3. They had an active Civil Engineering program.
4. The 'sample' included universities from a range of geographic locations.
5. The 'sample' included universities from a range of different 'groupings' of institution (i.e. research intensive, 'new' universities, regional universities etc.)
6. The 'sample' included universities of various sizes.

As each university confirmed participation in the Feasibility Study, they were contacted by the NPM and provided with an overview of the project. Institutional Coordinators were identified and directly contacted by the NPM to provide details on involvement in the project.

Across the two years of the project, students from 11 different Australian universities were involved. These institutions are listed below. Institutions with one asterisk (*) participated only in Phase One, these institutions generally cited resourcing issues as the key impediment to further participation. The one with two asterisks (**) participated only in Phase Two following an invitation from the NPM in early 2012. All other institutions listed were involved in both phases of the Feasibility Study.

- Charles Darwin University
- Curtin University of Technology*
- James Cook University
- Swinburne University of Technology
- The University of Adelaide
- The University of Melbourne
- The University of New South Wales*
- The University of Newcastle*
- University of Technology Sydney
- University of Western Sydney
- RMIT University**

Outcomes

In this section the broad outcomes from students in Australian institutions participating in AHELO are discussed. The discussion is relatively broad and focuses more on the participation levels than it does on the actual 'results' from the AHELO assessments.

Qualitative testing – Phase One

Phase One was carried out in ten participating institutions in Australia in April and in August 2011. In total 78 students took part in focus groups in which they were asked to take some sections of the draft assessment and then complete a survey and

provide feedback in a focus group setting. The draft assessments included in this session were:

- a Constructed Response task - where students are presented with a scenario or problem and asked a number of questions in relation to this. In most cases these required 'open answer' responses (i.e. they were not multiple choice); and
- a set of Multiple Choice questions.

All sessions were run within participating universities by the Institution Coordinator or a designated member of faculty. Sessions lasted approximately one hour and were undertaken by final year Bachelor of Civil Engineering students. Table 1 displays the demographic characteristics of the students who participated in the focus groups for Phase One.

Table 1: Focus group demographics

Demographics		***(n)***	***%***
Gender	Male	60	76.9
	Female	18	23.1
Age	20	4	5.1
	21	18	23.1
	22	26	33.3
	23	12	15.4
	24	9	11.5
	25	3	3.8
	26-30	3	3.8
	31 and above	2	2.6
Citizenship	Australia	54	69.2
	Other country	23	29.5
Language background	English	52	66.7
	Other language	25	32.1
Total students		78	100

After taking part in the test, students were asked to focus on the following topics during the moderated discussion:

- The task challenged me to think (***challenge***)
- The materials stimulated my interest in the task (***interest***)
- The task made me apply knowledge and skills in real-world ways (***apply***)
- The task assessed an appropriate range of knowledge and skills (***range***)
- The task was relevant to my program of study (***program***)
- The task was relevant to future professional practice (***future***)

The responses of students were scored and input into a national dataset for Phase One that was provided to the AHELO Consortium. At the national level, the National Centre undertook some analyses of the student responses.

The main outcomes derived from Phase One in Australia was that students rated the test mostly positively on the criteria of challenge, interest, application, range, relevance to program and future professional practice. The Constructed Response

tasks were rated slightly higher on these criteria compared to the Multiple Choice questions.

An overview of the Australian student responses to survey questions about the AHELO assessment instruments is provided in Figure 1 and Figure 2 below. They show that students were highly challenged by the Constructed Response tasks and were also generally positive about the other specific areas explored through the survey – with relevance to program and relevance to their future work being of particular interest (Figure 1). Levels of challenge and relevance to the degree program for these students was also relatively good for the Multiple Choice items, while the detail in Figure 2 suggests interests, application and the future relevance of these items were given lower scores by participating students.

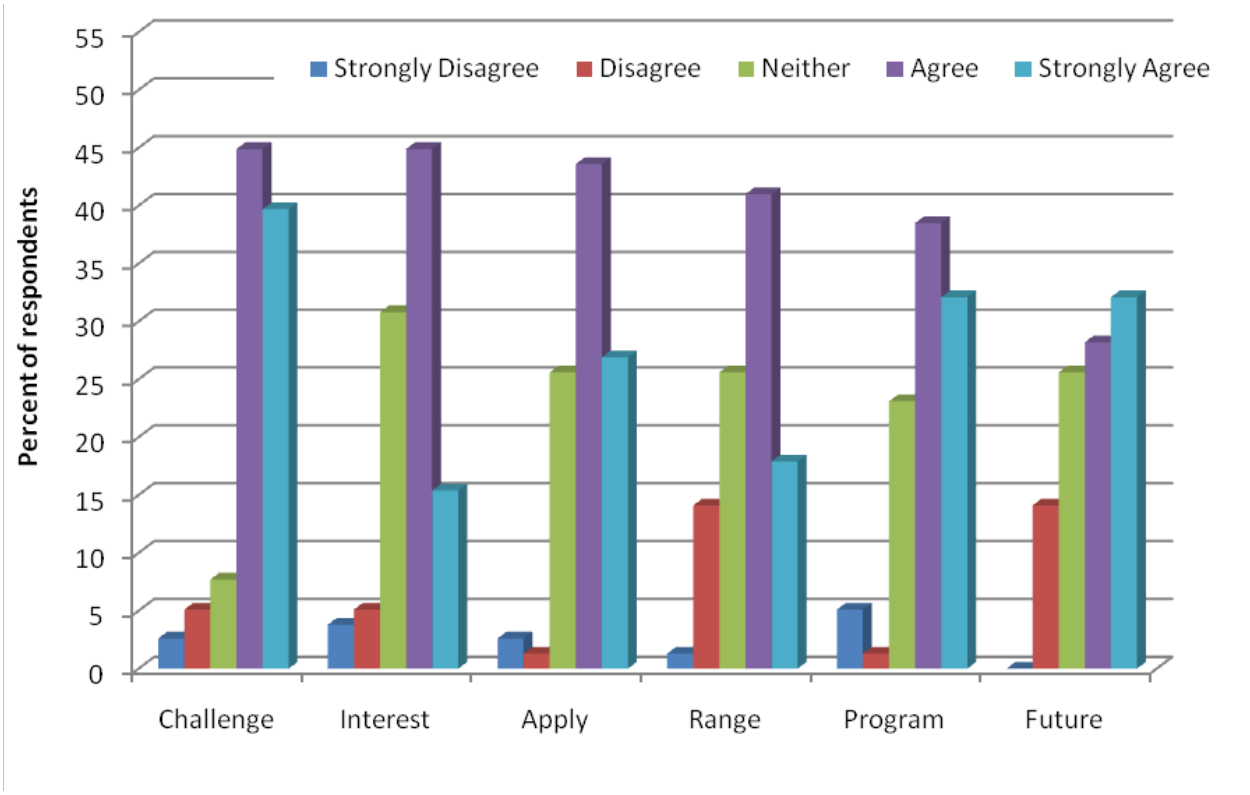

Figure 1: Feedback on Constructed Response Tasks

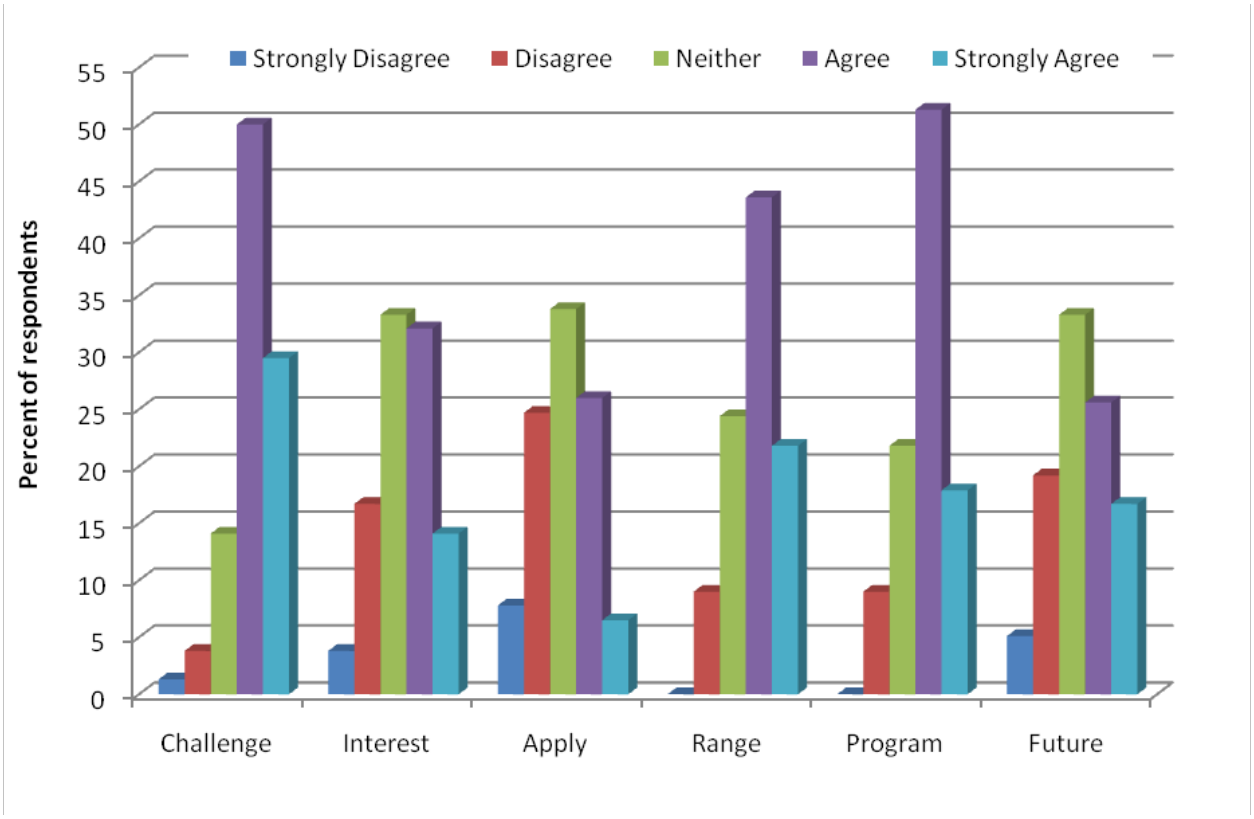

Figure 2: Feedback on Multiple Choice Tasks

In addition to rating the test through a questionnaire, the student focus groups also entailed a moderated survey format. In brief, the major responses of these moderated discussions were:

- When asked about the Constructed Response tasks, in general students found these made sense and the instructions were adequate. Overwhelmingly students found the task interesting, because of the diagrams, real-world problems, and because the test was different to how we students are tested usually.
- Student opinion about the Multiple Choice tasks was generally that these were more like the tasks they were familiar with at university. Students found the tasks to be more recall oriented and while relevant to their degree seemed less relevant in the long term for their future career.

A review of the draft assessment instruments was also undertaken by three academics in Civil Engineering from participating Australian universities. The outcomes of the academic review can be summarised as follows:

- In general, the feedback was similar to that of students.
- There was some suggestion that the content was focused on the early stages of degree, rather than final years.
- There was more specific item-based feedback relating to technical explanations, language used etc., suggested for change in order to make some items clearer.

Based on the results from the student focus groups and academic review both in Australia and in other participating countries, a number of changes were made by

the AHELO Consortium to the instruments used in the Civil Engineering strand. A major outcome at this point in the study was that more time was allocated for the test than originally planned. One Constructed Response task was completely removed from the test since it was too difficult. Other Constructed Response tasks were amended.

Quantitative testing – Phase Two

Phase Two of AHELO was conducted in 8 Australian universities in 2012. Students participating in the Feasibility Study undertook the AHELO Civil Engineering assessment, which involved a 90 minute test including one Constructed Response task and a module of Multiple Choice Questions. Students also completed a context questionnaire at the end of the test session which collected data relating to demographics and other background characteristics of students.

Sampling and student recruitment

A major task in preparing for test administration was the collection of sampling frames from each participating university in accordance with the AHELO protocol. To ensure international comparability of the AHELO data and to facilitate processing of the data collected, all participating institutions were required to provide lists of all eligible students and staff members, in a pre-defined table format. Internationally, this format enabled the validation of target populations and where necessary the selection of a sample. In Australia, Civil Engineering faculty sizes were sufficiently small to allow for a census rather than a sample. Eligibility for being included in the test population was defined as students enrolled in civil engineering programmes in their final year before Bachelor completion.

The provision of sampling frames to the NPM was a significant effort on the part of the institutional coordinators, since it required up-to-date information on the enrolment status of students and a range of demographic characteristics. Institutions were invited to add any background indicators to their sampling frames they deemed enriching to the data, and some provided information such as the programme students were enrolled in, country of birth of the student, or student aptitude measures such as grade point average. Other institutions were more constrained by regulations of data sharing, and were only able to provide essentials such as gender.

Test administration took place during April and May 2012 in all institutions. For the administration of the student assessment and questionnaire, most institutions organised a number of sessions, while other smaller institutions organised a single session. In some institutions, the institutional coordinator supervised all test administration sessions, whereas others hired test administration assistants financially supported through the NPM budget. During test sessions, the NPM was available for support regarding the AHELO test system and any other queries regarding the AHELO protocol.

A major challenge for the Australian implementation of AHELO was motivating students to participate in the study. This was a problem also highlighted by some

other countries during the international NPM meeting in October 2011. Given the variety of institutions participating in Australia, the NPM took a flexible approach to incentivising participation, allowing institution coordinators to propose localised incentive ideas that were agreed to and funded by the NPM. Table 2 details the kinds of incentives offered by institutions to participating students. It shows a range of different options and approaches offered. In some institutions, full student population numbers were small enough to offer a voucher to each participant, in others it was necessary to have a draw of prizes for participants. Besides monetary incentives, students were motivated to participate by explaining to them the relevance of the test to their future work experience, and the value of their participation to the success of the study. One university chose not to offer any monetary or 'prize' incentives for students and instead focus solely on the experience of the assessment as being an incentive for participants.

All institutions were provided with participation certificates to provide to students who sat the test. These certificates were developed by the AHELO Consortium and the OECD and included the OECD logo.

Table 2: Student participation incentives

Institution	*Incentive*
Uni A	$AU100 voucher for each participant
Uni B	ipad draw. Lunch and discussion of Outcomes Assessments for participants
Uni C	$AU50 voucher for participating students
Uni D	ipad draw. Voucher draw in each room (8 different sessions) chance in each room to win $AU200 or a $AU100 voucher.
Uni E	2 ipads drawn, 5 $AU50 vouchers drawn, a lunch
Uni F	$AU1000 prize draw, and offering student society $AU1000 for a high overall participation rate (75% - not achieved).
Uni G	none
Uni H	Made test a 'requirement' for a core subject.

Table 3 provides the participation numbers and participation rates (based on the numbers of eligible participants identified through the selection of a sampling frame) for both students and staff for each university. In total 187 students from Australian institutions participated in the AHELO assessment. Across the institutions involved, one in five final year civil engineering students participated in the assessment. However, this average does not adequately represent the notable variation in participation rates of students between institutions. Five of the eight institutions had participation rates below 25 per cent, while one institution (Uni H) had almost full participation from its cohort.

Table 3: Participation numbers and participation rates of students, Australian institutions for AHLEO

Institution	*Number of participants*	*Participation rate* (%)*
Uni A	3	30.0
Uni B	27	12.3
Uni C	4	12.5
Uni D	29	19.3
Uni E	27	29.0
Uni F	25	14.2
Uni G	19	12.8
Uni H	53	98.1
Total	187	21.1

*The participation rate is based on the number of participating students as a proportion of the full student population identified in the sample frames constructed by institutions for the study.

Numerous issues affected the participation rates of students in Australia. These included students having limited 'on-campus' time in their course due to final year internships, a large proportion of students in part-time work and therefore little or no free time, and short notice of the testing window.

However, as the table shows, the Uni H was able to secure a large participation rate, proving that it is possible within Australian higher education to achieve wider engagement of the student cohort in this kind of exercise. Given the success of this institution in securing this level of engagement from students, further information of their approach is detailed in the box below.

Successful engagement model

The approach taken by the Uni H offers an insight into an ideal implementation model. The approach involved strong and dispersed leadership within the institution, insightful planning, and the merging of the assessment into a dialogue about learning outcomes between students and staff.

The implementation of AHELO at this institution was planned in advance, beginning in November the year prior to testing – four months before testing – following an information session facilitated by the National Project Manager. Leadership in the project came at three levels within the institution – from the Chancellery, where a member of the Pro-Vice Chancellor's office was directly involved, from the Head of the School of Engineering and from a senior faculty member who had ultimate responsibility for implementation. During planning for the testing, the team within the institution identified a core unit (a project/thesis unit) in its final year civil engineering program in which the theme of learning outcomes and graduate capabilities was appropriate. The unit was planned in such a way that AHELO became an integral part of the work during the semester. Students were asked to undertake the assessment as part of the unit of study and following the assessment, were involved in discussions to reflect on their assessment experience and the relationship between their coursework, the skills they expected to employ in the workforce following graduation and professional responsibility related to assurance of educational and practice standards.

Participant characteristics

The characteristics of the student participants in AHELO are displayed in Table 4. Notable student demographics include the dominance of male students in engineering, and the high proportion of students with a main language other than English. The average age of students participating was 23.2. Most students were studying full-time and on campus. A basic comparison of the sample frame with the secured participation group suggests that by gender the sample is representative, although it appears that the participant age may be slightly older on average than the full population.

Table 4: Student participant characteristics

Characteristic	Category	Participant population (% of total)
Gender	Male	80.1
	Female	19.9
Age	20 and below	5.3
	21	20.5
	22	30.4
	23	19.3
	24	9.4
	25-30	11
	Above 30	4
Enrolment type	Mainly part time	4.1
	Mainly full time	95.9
Enrolment mode	Entirely on-campus	91.2
	Mix of external/distance and on-campus	8.8
Country of birth	Australia	53.8
	China	14.6
	India	2.9
	Malaysia	5.8
	Other	22.8

Assessment outcomes

Discussion relating to the data outcomes from AHELO participation by Australia is limited in this paper due to the fact that this data is relatively sensitive and the sample numbers and representativeness of students for most of the universities involved in Australia was below the level that would be required for the collection of reliable data. Instead, some relatively broad level findings are shown here using the full Australian data set. Two issues are discussed – relationship between student grades and outcome on AHELO, and the link between work 'practice' and outcomes in AHELO. For broad reference, in examining the scores below, the international mean for AHELO is 500 with a standard deviation of 100.

Figure 3 shows the relationship between student outcomes on the AHELO assessment and their grades during university study – self-reported by students. It

clearly shows that the Australian students who identified themselves as being among the top in their class achieved a much higher average score in AHELO than other students. This goes some way to suggesting there is some concurrent validity present in the AHELO instruments.

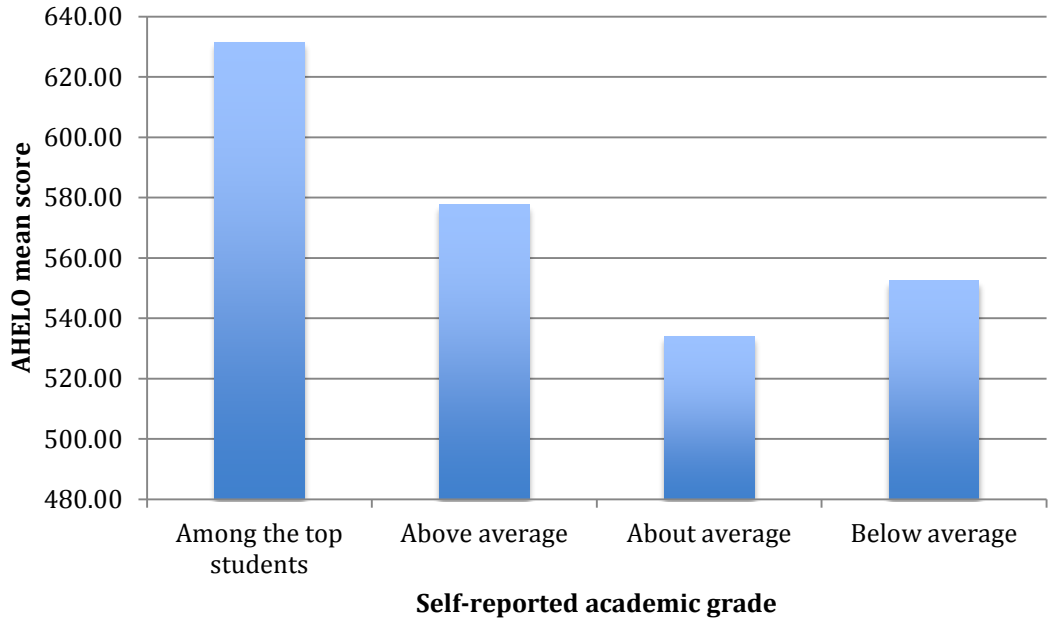

Figure 3: AHELO mean score by self-reported outcome in university studies, Australian participants

An important issue in Australian Higher Education is the link between study and work and the extent to which study is preparing young people for their future careers. The outcomes from Phase One displayed earlier suggested that at leas in terms of the content of the tests, students saw substantial relevance with future work in the Constructed Response tasks. Interestingly, the AHELO data for Australia shows that those students who are engaged in paid work relating to their degree in their final year of university, and those who are planning to work in the industry related to their study when they graduate are much more likely to have higher scores than students not currently and not planning on working in their field in the future.

Figure 4 shows that students who worked at least six hours – but less than 31 hours – per week in a paid job that was related to their study on average had a higher outcome on the AHELO assessment than those not working in a paid job in a related field or those working more than 30 hours in such employment. This is an interesting finding in the context of considering the extent to skills gathered through working in the field might help influence the extent to which students were able to successfully answer questions in the AHELO assessment. It also suggests that for those students with a very heavy work burden during their final year of study (paid work of more than 30 hours), this paid work may be having an adverse impact on their ability to perform at university.

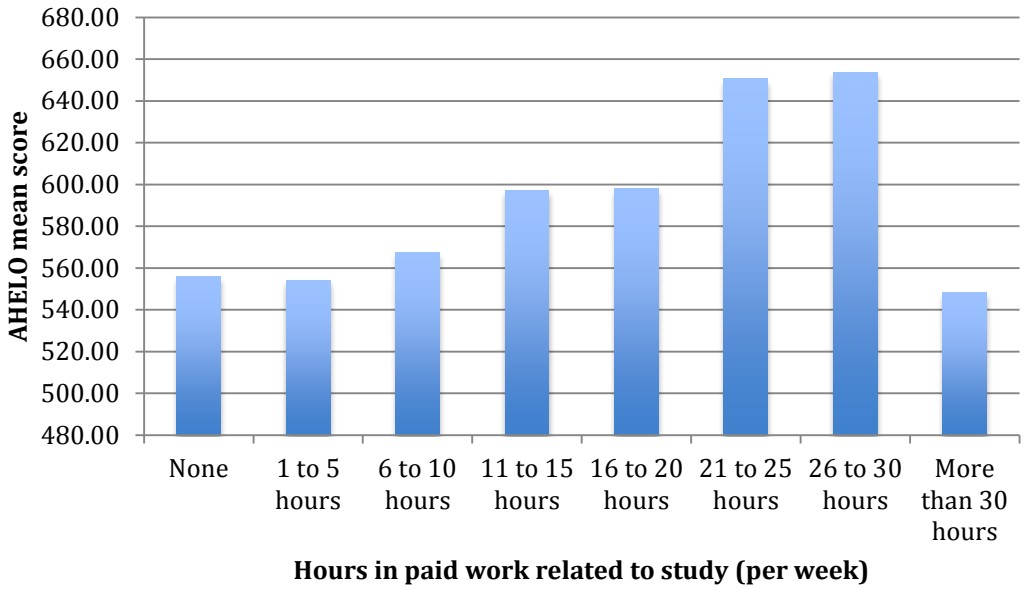

Figure 4: AHELO mean score by number of paid hours worked in job related to study per week, Australian participants

The other work-study related issue that shows some interesting data among the Australian participants in AHELO relates to the post-graduation ambitions of students. The data in Figure 5 indicate strongly that those students who had plans to pursue a career in Civil Engineering straight after completing their degree were clearly more likely to have a higher score on the AHELO assessment. It is likely that these are more motivated students at this time in their degree and perhaps more focussed than those students with no plan to pursue work in the field. Interestingly, those students intending on pursuing further study in the area had a higher mean score than those not planning on working in the field, but lower than those intending on entering the Civil Engineering workforce.

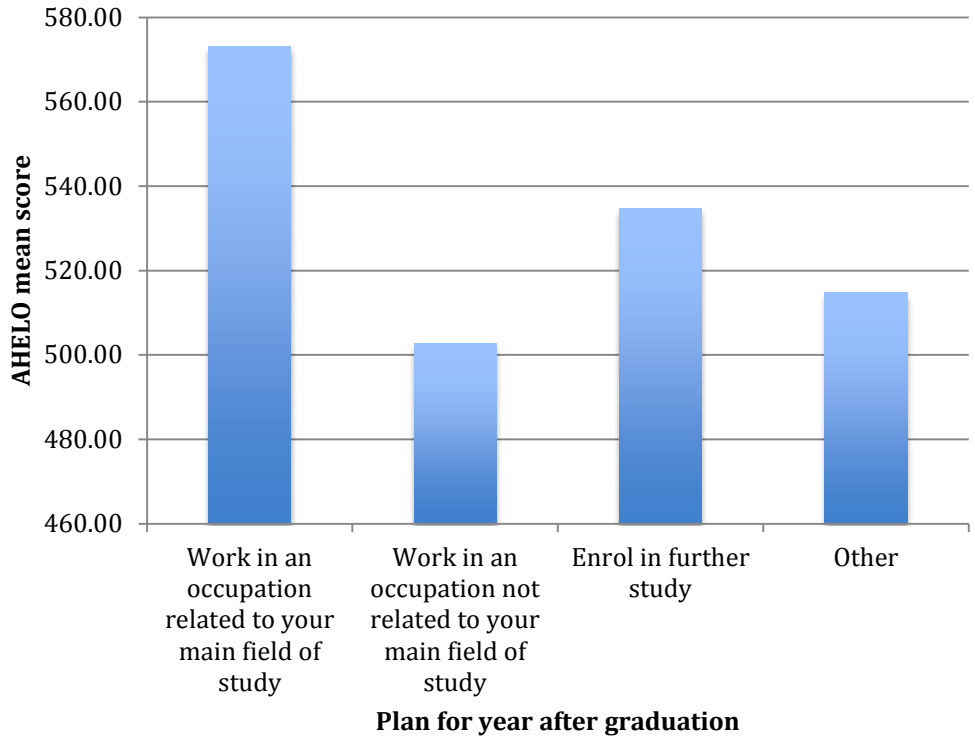

Figure 5: AHELO mean score by pathway planned by student following graduation, Australian participants

Conclusion and ideas for the future

The Australian participation in the AHELO feasibility study has resulted in a number of valuable lessons. Firstly, it has shown that the Australian sector is equipped to participate in this type of international study. There was interest from stakeholders in participating, and administrative systems in institutions allowed relatively straightforward production of the required student and staff data. The process of a National Centre overseeing a network of institutional coordinators functioned well, and coordinators report finding this type of cooperation valuable.

Secondly, participation in the process of developing and trialling an internationally applicable engineering test has proven to be insightful both to participating institutions and students. AHELO has proven to be a truly ground-breaking test in the sense that students reported not having been exposed previously to the type of applied, integrated problems mirroring their future work. The cooperation between engineering experts from multiple countries both in meetings and via online communication has provided an excellent opportunity to strengthen international bonds. In addition the cooperation between participating institutions opened up opportunities for future cooperation within engineering faculties.

In practical terms, AHELO has shown that students in Australia are not easily motivated to participate in a voluntary test or questionnaire. Future iterations of AHELO or similar studies would do well to integrate as much as possible these types of assessment into the curriculum, using implementation models such as that used by Uni H. Though participation rates in the feasibility study for Australia were

disappointing, the process of implementation has built substantial knowledge on the processes and systems needed for engagement among students and institutions in future studies of this kind.

AHELO has provided some small insights into the current state of engineering bachelor education at selected universities in Australia. While this data does not allow any strong conclusions about the skill level of Australian students as it compares to that of students in other countries (and therefore reduces the outcomes analysis of this paper), it allows a glimpse into what could be possible in future iterations of the study. Importantly, involvement in the AHELO Feasibility Study has provided Australia with valuable lessons and models for future implementation of such assessments in the future.

For Australia, there are some worthwhile considerations for future international participation that have become apparent through the feasibility study. One is that in the testing window used in this phase, Australian students were technically one semester behind those from institutions in other countries (except Japan). The test window fell in Semester 1 of the final year of the Australian students, but in the final semester of study for those in most other participating countries. For accurate international comparisons, future iterations of the study should be implemented in comparable times during academic years across all countries. A second is that a number of the institutions involved in the Australian participation have substantially large final year internships or research projects in the final year, meaning that students spend significant time in this year off-campus. As such, being able to find a time in which a large cohort is able to participate in a secure assessment is difficult for institutions. Longer term planning for the running of such assessment could help in minimising the impact of these key events in the final year. However, the importance of the flexibility of internships and research projects may make this a challenge to achieve. A final issue recommended for consideration in the future is the production of student-level reports for individuals who participate. It is recognised that this was beyond the scope of the feasibility study, but Australia believes building such capabilities in the future would help to stimulate engagement of students in these types of studies.

Since the conclusion of the Feasibility Study, the Australian NPM has worked with colleagues on identifying useful ways of developing reports for institutions within the constraints of the study (in particular the fact that the assessment items are still secure and confidential). Some innovative work has been undertaken in this regard and an example institution level and national level summary report are presented at the end of this paper. These reports show outcomes at the individual item level, order items by level of difficulty, and provide a reference to the *type* of capability being tested by each item. The example here is a useful one in consideration of developing such reporting in the future. It is the opinion of the author of this paper that greater momentum following the implementation of the Feasibility Study would have been gained by having clearer and more detailed reporting at the student and institution level.

Acknlowledgements
Thanks to colleagues and members of the ACER Consortium for advice and content for this paper and assistance throughout the Feasibility Study Eva van der Brugge, Sarah Richardson, Hamish Coates, Jacob Pearce, Yan Bibby and Xiaoxun Sun.

EXAMPLE OF FORMAT FOR REVISED INSTITUTIONAL REPORT – PATTERNS OF STUDENT PERFORMANCE

Civil Engineering Learning Outcomes
Item Code Description

Engineering Generic Skills	
A	use diverse methods to communicate effectively with the engineering community and with society at large
B	demonstrate awareness of the wider multidisciplinary context of engineering
Basic and Engineering Sciences	
C	demonstrate knowledge and understanding of the scientific and mathematical principles underlying civil engineering
D	demonstrate a systematic understanding of the key aspects and concepts of their branch of engineering
E	demonstrate comprehensive knowledge of materials and construction
F	demonstrate comprehensive knowledge of structural engineering
G	demonstrate comprehensive knowledge of geotechnical engineering
H	demonstrate comprehensive knowledge of hydraulic engineering
I	demonstrate comprehensive knowledge of urban and rural planning.
Engineering Analysis	
J	apply knowledge and understanding to identify, formulate and solve engineering problems using established methods
K	apply knowledge and understanding to analyse engineering products, processes and methods
L	select and apply relevant analytic and modelling methods
M	conduct searches of literature, and to use databases and other sources of information
N	design and conduct appropriate experiments, interpret the data and draw conclusions
O	demonstrate workshop and laboratory skills
Engineering Design	
P	apply knowledge and understanding to develop designs to meet defined and specified requirements
Q	demonstrate an understanding of design methodologies, and an ability to use them
Engineering Practice	
R	select and use appropriate materials, equipment and tools
S	combine theory and practice to solve engineering problems
T	demonstrate understanding of applicable techniques and methods, and their limitations
U	demonstrate understanding of the non-technical implications of engineering practice
V	demonstrate understanding of the health, safety and legal issues and responsibilities of engineering practice
W	demonstrate knowledge of project management and business practices

AHELO Feasibility Study 2012

Example Australian University

Civil Engineering Learning Outcomes

Constructed Response Tasks

Partial Credit Item Score

Not Administered

Task*	Item	Item description code	Average Raw Score: AHELO Sample	Average Raw Score: Australian Sample	Average Raw Score: This Institution	0000000000021	0000000000052	0000000000008	0000000000020	0000000000023	0000000000003	0000000000006	0000000000007	0000000000043	0000000000051	0000000000019	0000000000036	0000000000001	0000000000011	0000000000014	0000000000015	0000000000018	0000000000022	0000000000030	0000000000041	0000000000045	0000000000002	0000000000013	0000000000016	0000000000024	0000000000027	0000000000032	0000000000033	0000000000034	0000000000035	0000000000046	0000000000005	0000000000012	0000000000025	0000000000037	0000000000042
Task 1 Dams	ENGCRTM17	B, U, V	0.9	0.9	0.6											1		0		1	1	1				1		1			1	1	1	0	0					
	ENGCRTM16	U, V, W	0.7	1.0	0.9											1		1		1	1	1				1		1			1	1	1	1	1					
	ENGCRTM14	V	0.7	0.9	0.9											1		1		1	1	0				1		1			1	0	1	1	0					
	ENGCRTM11	D, J	0.7	0.9	1.1											2		2		1	1	2				0		1			1	1	1	2	2					
	ENGCRTM15	K, L	0.7	0.9	0.9											2		1		1	1	1				1		1			1	1	1	1	1					
	ENGCRTM12	Q	0.5	0.5	0.5											0		1		1	1	1				1		0			0	1	0	0	1					
Task 2 Storm Barriers	ENGCRTM28	M, W	1.2	2.1	2.1	4	3	2	4	3	3	3	4		3		2						2						2						1		2	2		
	ENGCRTM23	P, R	0.6	0.7	0.6	1	1	1	1	1	1	1	1		0		1						1						1						0		0	1		
	ENGCRTM24	S	0.6	1.3	1.1	2	2	2	2	2	2	1	2		2		0						1						2						0		2	0		
	ENGCRTM25	O, Q	0.4	0.7	0.5	1	1	1	0	1	0	1	1		1		1						0						0						1		0	0		
	ENGCRTM27	M, T	0.4	0.5	0.4	0	1	2	1	1	1	0	0		0		1						0						0						1		0	0		
	ENGCRTM21	K	0.4	0.5	0.4	1	1	0	0	0	1	0	0		1		1						1						0						1		0	0		
	ENGCRTM26	D, T, V	0.3	0.4	0.4	1	0	1	1	1	0	1	0		0		1						0						0						0		0	1		
	ENGCRTM22	J, Q	0.2	0.3	0.2	0	1	0	0	0	0	1	0		1		0						1						0						0		0	0		
Task 3 Concrete and Bridges	ENGCRTM36	A, B, U	1.3	2.2	2.4									3					3						3		3			3						2			3
	ENGCRTM34	T	0.7	0.8	0.6									1					1					1	1	1		1		0						1			0
	ENGCRTM33	K	0.7	0.7	0.6									1					1					1	1	1		0		0						0			1
	ENGCRTM32	D, T	0.6	0.4	0.4									1					0					1	1	0		1		1						0			0
	ENGCRTM35	L, O	0.5	0.6	0.4									1					1					0	0	1		0		1						1			0
	ENGCRTM31	N	0.1	0.1	0.1									1					0					0	0	0		0		0						0			0

*Each student was administered one task.

Example Australian University

Civil Engineering Learning Outcomes

Multiple Choice Items

1 **Correct** 0 **Incorrect**

Not Administered

Set*	Item	Item description code	% Correct: AIELO Sample	% Correct: Australian Sample	% Correct: This Institution	0000000000013	0000000000002	0000000000019	0000000000021	0000000000035	0000000000015	0000000000044	0000000000007	0000000000024	0000000000036	0000000000053	0000000000006	0000000000011	0000000000014	0000000000016	0000000000028	0000000000038	0000000000041	0000000000048	0000000000003	0000000000008	0000000000009	0000000000012	0000000000023	0000000000026	0000000000027	0000000000032	0000000000039	0000000000043	0000000000045	0000000000050	0000000000005	0000000000020	0000000000029	0000000000033	0000000000040
	ENGMCQ3	G	54	81	72	1	1	1		1		1	1	1	1	1	1	0	0	0	1	0	1	1	1	0	1	1	0	1			1	1	1	1	1	1	1	0
Set 1	ENGMCQ1	C	51	47	49	1	1	1		1		0	0	0	1	0	0	1	0	1	1	1	0	1	1	0	1	0	0	0			0	1	0	1	1	1	1	1
	ENGMCQ2	E	35	36	16	0	0	1		1		0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0			0	0	0	0	0	1	0	0
	ENGMCQ5	H	20	18	14	0	0	0		0		0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0			0	1	0	0	1	0	0	1
	ENGMCQ7	C	61	57	57	1	1	1	1	1	1	1	1	1	0	0	1		1			1	1	0	1	1	1	0	0	0	1	1	0		1	0		0	0		1
	ENGMCQ8	F	54	50	36	1	1	1	0	0	0	0	1	1	1	0	1		1			0	0	0	1	0	1	0	0	0	0	0	0		0	1		1	0		0
Set 2	ENGMCQ9	F	54	64	59	1	1	1	1	1	1	1	1	1	1	1	0		1			1	1	0	1	1	0	1	1	0	1	0	0		1	0		1	0		1
	ENGMCQ10	G	50	51	27	1	1	0	0	0	0	0	0	0	0	1	0		1			1	0	0	1	0	0	1	1	0	0	0	0		0	0		0	0		0
	ENGMCQ6	C	47	55	41	1	1	1	1	1	0	1	0	0	0	1	0		0			0	0	0	1	1	1	0	1	0	0	1	0		0	0		0	1		0
	ENGMCQ13	C	55	66	53	1		1	1	1	1		1	0	1			1	1	0	1		1	1	0	1	0		1	1	1	1	0	0	1	0	0		0	1
	ENGMCQ14	E	33	30	19	0		0	1	0	0		1	1	1			0	0	0	0		0	0	0	1			1	0	0	0	0	1	0	0	0		0	0
Set 3	ENGMCQ11	H	28	34	14	1		0	0	1	1		0	0	0			0	0	0	1		0	1	0	0	0			0	0	0	1	0	0	0	0	0		0	0
	ENGMCQ12	H	26	24	16	0		0	1	0	0		1	0	0			0	0	0	0		0	0	0	0			1	0	0	1	0	0	1	0	1		1	0
	ENGMCQ15	E	22	25	16	0		1	0	0	0		0	1	0			0	0	1	0		0	1	0	0	0			0	0	0	1	0	0	0	0	0		0	0
	ENGMCQ16	F	59	57	40		1	1	1	0	1	1			0	0	1	1	1	0	1	0	1		0	0	1	0	1	1	1	0		0		0	1	1	0	1	0
	ENGMCQ20	I	45	57	47		1	1	0	1	1	1			1	0	1	0	1	0	1	0	1		0	0	1	0	0	1	1	1		1		1	0	0	0	1	0
Set 4	ENGMCQ18	F	40	41	44		1	0	1	1	1	1			1	1	1	1	0	1	0	0	0		0	1	0	1	1	1	1	0		0		1	0	0	0	0	0
	ENGMCQ17	G	25	31	20		0	0	0	0	0	0			0	1	0	0	0	1	1	0	0		0	1	0	0	0	0	0	0		1		0	0	0	1	0	1
	ENGMCQ19	H	18	14	16		0	1	0	1	0	0			1	1	1	0	0	0	0	0	0		0	0	0	0	0	0	1	1		0		0	0	0	0	0	0
	ENGMCQ22	F	48	49	26	1	1		1		0	1	0	1	0	1	0	0	0	0	0	0	0	1	0		0	0	0	0	0	0	0	0	1	0	0	0	0	0	
	ENGMCQ23	G	38	42	39	0	0		1		1	0	0	1	0	0	0	1	1	1	1	0	1	0	0		0	1	1	0	1	0	0	1	0	1	1	0	1	1	
Set 5	ENGMCQ25	I	32	51	52	1	1		1		0	1	1	0	0	1	1	1	1	1	0	1	1	0	0		0	1	0	1	0	0	1	1	1	0	1	0	1	0	
	ENGMCQ21	C	27	30	13	1	0		0		0	0	0	1	0	0	0	1	0	0	0	0	0	0	0		0	0	0	0	1	0	0	0	0	0	0	0	0	0	
	ENGMCQ24	H	24	32	20	0	0		1		1	0	0	0	0	0	0	0	0	1	0	1	1	0	0		0	0	0	0	0	0	0	1	0	0	0	1	1		
	ENGMCQ29	F	63	70	61	1	1	1	1	1	1	1	1	0		1	1	1		1	0	1		0		1		0	0		0	1	0	1	1		1	0	0	0	
Set 6	ENGMCQ27	F	31	31	27	1	0	0	0	0	1	1	0	0		0	0	0		0	0	1		1		1		1	1		0	0	1	0	0		0	0	0	0	
	ENGMCQ30	H	16	22	9	0	0	0	0	0	0	0	1	1		0	0	0		0	1	0		0		0		0	0		0	0	0	0	0		0	0	0	0	1
	ENGMCQ28	I	6	6	14	0	0	0	0	0	0	0	0	0		0	0	0		0	0	1		1		0		1	0		0	1	1	0	0		0	0	0	0	

*Each student was administered 5 out of 6 item sets.

EXAMPLE OF FORMAT FOR REVISED NATIONAL SUMMARY REPORT

AHELO Feasibility Study 2012

Australian Institutions

Civil Engineering Learning Outcomes

Constructed Response Tasks

Partial Credit Item Scores

Not Administered

Task	Item	Item description code	Average Raw Score									
			AHELO Sample	Australian Sample	Institution 3	Institution 4	Institution 9	Institution 6	Institution 2	Institution 5	Institution 10	Institution 1
Task 1 Dams	ENGCRTM17	B, U, V	0.9	0.9	1.0	0.9	1.4	0.8	1.2	0.9	0.6	
	ENGCRTM16	U, V, W	0.7	1.0	1.0	1.0	1.0	0.9	1.0	1.0	0.9	
	ENGCRTM14	V	0.7	0.9	1.0	1.0	1.2	0.7	1.0	0.9	0.9	
	ENGCRTM11	D, J	0.7	0.9	1.0	0.8	0.8	0.8	0.7	1.0	1.1	
	ENGCRTM15	K, L	0.7	0.9	1.0	1.0	1.0	0.9	1.0	0.9	0.9	
	ENGCRTM12	Q	0.5	0.5	1.0	0.6	1.2	0.2	0.5	0.6	0.5	
	ENGCRTM28	M, W	1.2	2.1	3.0	2.7	1.5	2.7	2.0	1.8	2.1	1.0
Task 2 Storm Barriers	ENGCRTM23	P, R	0.6	0.7	0.0	0.6	0.9	1.1	0.8	0.4	0.6	1.0
	ENGCRTM24	S	0.6	1.3	2.0	1.7	1.4	1.1	1.6	1.5	1.1	1.0
	ENGCRTM25	O, Q	0.4	0.7	1.0	0.7	0.9	1.0	0.4	0.8	0.5	0.3
	ENGCRTM27	M, T	0.4	0.5	1.0	0.3	0.9	0.8	0.0	0.5	0.4	0.3
	ENGCRTM21	K	0.4	0.5	1.0	0.4	0.4	0.4	0.4	0.6	0.4	0.3
	ENGCRTM26	D, T, V	0.3	0.4	1.0	0.7	0.3	0.3	0.4	0.3	0.4	0.7
	ENGCRTM22	J, Q	0.2	0.3	1.0	0.3	0.3	0.6	0.4	0.4	0.2	0.7
	ENGCRTM36	A, B, U	1.3	2.2	2.5	2.5	2.1	2.0	1.8	1.7	2.4	
Task 3 Concrete and Bridges	ENGCRTM34	T	0.7	0.8	0.5	0.9	0.9	0.7	0.8	0.9	0.6	
	ENGCRTM33	K	0.7	0.7	1.0	0.7	0.7	1.0	0.8	0.7	0.6	
	ENGCRTM32	D, T	0.6	0.4	0.0	0.8	0.3	0.3	0.4	0.1	0.4	
	ENGCRTM35	L, O	0.5	0.6	1.0	0.6	0.6	0.8	0.7	0.6	0.4	
	ENGCRTM31	N	0.1	0.1	0.0	0.0	0.0	0.2	0.4	0.1	0.1	

AHELO Feasibility Study 2012

Australian Institutions

Civil Engineering Learning Outcomes

Multiple Choice Items

Item Percentage Correct

Not Administered

Set	Item	Item description code	% Correct									
			AHELO Sample	Australian Sample	Institution 5	Institution 4	Institution 6	Institution 9	Institution 3	Institution 2	Institution 10	Institution 1
Set 1	ENGMCQ3	G	54	81	95	82	95	94	100	43	72	100
	ENGMCQ1	C	51	47	73	41	40	35	0	57	49	0
	ENGMCQ2	E	35	36	18	45	60	59	50	36	16	100
	ENGMCQ5	H	20	18	23	23	20	12	50	14	14	0
Set 2	ENGMCQ7	C	61	57	65	65	38	50	50	65	57	50
	ENGMCQ8	F	54	50	39	52	62	56	75	71	36	50
	ENGMCQ9	F	54	64	61	78	62	69	50	71	59	0
	ENGMCQ10	G	50	51	78	61	52	63	100	41	27	0
Set 3	ENGMCQ6	C	47	55	65	70	67	63	25	41	41	50
	ENGMCQ13	C	55	66	81	67	64	77	100	73	53	0
	ENGMCQ14	E	33	30	42	26	36	46	33	33	19	0
	ENGMCQ11	H	28	34	62	37	55	31	33	20	14	0
Set 4	ENGMCQ12	H	26	24	35	26	27	15	33	27	16	0
	ENGMCQ15	E	22	25	42	30	23	23	0	20	16	33
	ENGMCQ16	F	59	57	38	76	62	76	67	63	40	100
	ENGMCQ20	I	45	57	67	52	71	65	67	50	47	67
	ENGMCQ18	F	40	41	52	28	38	53	33	25	44	67
	ENGMCQ17	G	25	31	43	60	38	18	0	6	20	67
	ENGMCQ19	H	18	14	19	16	14	6	0	13	16	0
	ENGMCQ22	F	48	49	63	75	57	53	33	53	26	0
Set 5	ENGMCQ23	G	38	42	54	33	52	33	33	27	39	100
	ENGMCQ25	I	32	51	46	58	43	47	0	67	52	67
	ENGMCQ21	C	27	30	42	42	33	33	33	33	13	33
Set 6	ENGMCQ24	H	24	32	58	29	33	40	100	13	20	0
	ENGMCQ29	F	63	70	95	71	50	82	100	77	61	50
	ENGMCQ27	F	31	31	32	42	25	35	33	31	27	0
	ENGMCQ30	H	16	22	32	25	35	18	67	23	9	0
	ENGMCQ28	I	6	6	5	0	0	6	0	0	14	0