Contents

- Personal and Social Capability
- Intercultural Understanding
- Ethical Understanding (ACARA, 2013).

In recognition that 21st century skills are important components of the curriculum, which require new modes of assessment and that this is shared problem that would benefit from networked global exploration, ACARA and NSW DoE joined the Collaborative

Assessment of collaborative problem-solving

Two projects of particular significance to the Collaborative Problem-solving Online Assessment and the Australian Curriculum project are:

- Assessment and Teaching of 21st Century Skills project (ATC21S)
- PISA 2015 Collaborative Problem-solving (CPS) assessment.

Assessment and Teaching of 21st Century Skills project (ATC21S)

As a result of the ATC21S™ project, empirical progressions for collaborative problem-solving (CPS) were developed and published. These provide descriptions of skills at different levels of development. The ATC21S cognitive

The draft collaborative problem-solving tasks for PISA 2015 vary in length and a number of tasks are used to obtain evidence across all indicators. It is intended that students, using pre-programmed responses, collaborate with an avatar (computer agent) and not with another student. Using an avatar with pre-programmed responses makes the automation of scoring and analysis much easier/simpler. The results of a Rosen and Tager 2013 study suggest that “by using computer agents in a CPS task the students were able to show their collaborative skills at least at the level of that of their peers who collaborated with human partners. However, … each mode of collaboration involves limitations and challenges” (Rosen and Tager, 2013: 27).

- **Develop and provide access to high quality assessment tasks that elicit valid, reliable data on students collaborative problem-solving skills**

THE DRAFT AUSTRALIAN CURRICULUM COLLABORATIVE PROBLEM-SOLVING ASSESSMENT FRAMEWORK

The elements for the draft Australian Curriculum Collaborative Problem-solving Assessment Framework (ACCPSAF) have been informed by the:

- Australian Curriculum: General capabilities selected for the purposes of this project including Critical and Creative Thinking (CCT) and Personal and Social Capability (PSC)
- criteria from the Assessment and Teaching of 21st century skills (ATC21S) Hesse et al (2012) tables for social skills and cognitive skills in collaborative problem-solving
- descriptions in the Five Strands presentation of the Collaborative Problem-solving Empirical Progressions (ATC21S, 2014)
- PISA 2015 draft Collaborative Problem-solving Framework.

Relationship to the Australian Curriculum general capabilities

Collaborative problem-solving relates particularly to two of the Australian Curriculum general capabilities, Critical and Creative Thinking and Personal and Social Capability.

The general capability of Critical and Creative Thinking is described in terms of the elements of inquiring, generating ideas, reflecting and analysing based on the works of a number of theorists including Bloom et al 1956, and Anderson and Krathwohl 2001.

Personal and Social Capability is described in terms of the elements of self-awareness, self-management, social awareness and social management. These are based on the five competencies (self-awareness, self-management, social awareness, relationship skills and responsible decision making) identified by the Collaborative for Academic, Social and Emotional Learning (CASEL) at the University of Illinois Chicago, founded by Goleman et al in 1994.

Table 1: Relationship between the Australian Curriculum general capabilities and the Australian Curriculum Collaborative Problem-solving Assessment Framework (ACCPSAF) indicators

Australian Curriculum general capability		**Australian Curriculum Collaborative Problem-solving Assessment Framework**	**Australian Curriculum general capability**		**Australian Curriculum Collaborative Problem-solving Assessment Framework**
Critical and Creative Thinking			Personal and Social Capability		
Element	**Sub-element**	**Indicator**	**Element**	**Sub-element**	**Indicator**
Inquiring-identifying, exploring and organising information and ideas	Pose questions	Poses questions, clarifies	Self-awareness	Recognise emotions	
	Identify and clarify information and ideas	Collects and organises information		Recognise personal qualities and achievements	
	Organise and process information			Understand	

DESIGN OF THE TASKS AND THE ONLINE ENVIRONMENT

Care and Griffin utilised activity logs or log-files, the time-stamped record of what a program does and the detail of the student's activity. Log-files can be used to describe actions and interaction referred to as process data, but there are also outcome data.

Statistical models should accurately describe the dynamics of t

The tasks provide sufficient opportunity to generate data that would allow the interpretation of a student's performance. Although there is a context for each of the tasks, care has been taken to ensure that no requisite knowledge is needed to complete the tasks. The tasks have been scaffolded into several parts. As the tasks progress, each part demands greater levels of problem-solving and collaboration skills.

To maximize data for research and development, an assessment session begins with a survey of the students' attitudes to solving problems and working with others, and ends with a survey of their responses to the tasks and to working with their partners. See **Appendix D** for a copy of the pre- and post-survey questions.

One of the tasks is described below. See **Appendix C** for the scoring rubric for Task 1: Lights out.

Year 8: Lights out

The task is set around the problems associated with using electrical equipment. Care has been taken that only basic knowledge of electric circuits, as experienced in the home and assumed as known by primary school students, is needed to complete the task.

Initially the student is introduced to the task through a virtual scenario of being faced with a darkened room and the student is set the challenge to determine the functionality of a range of electrical components.

The student begins the task individually setting up a circuit based on instructions This is intended to develop a

communities. The ability to capture students' thinking and communication with others, along with indicators of their level of knowledge and skills, has the power to transform models of assessment.

An evaluation engine is built into the design of each task. This enables the students' work to be analysed in real time, awarding achievements at specific levels for indicators based on criteria defined in the task design. A key innovation in this approach is a model to allow tasks to continuously score via indicators and levels throughout the actual collaborative process. Actions within the space, as well as communications in the chat box are also recorded to allow the use of algorithms to code and rescore direct actions and provide metadata from the chat box. This provides the mechanism for measuring students' collaborative pr

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TRIALLING AND PRELIMINARY FINDINGS

A proof of concept trial of one task was conducted in July 2015 with 900 Year 9 students in nine

Random pairing

In the PISA 2015 draft collaborative problem-solving tasks, students collaborated with an avatar (computer agent) using pre-programmed responses and not with another student. The advantage of using an avatar with pre-programmed responses is that it makes for much easier/simpler automation of scoring and analysis; however, it is labour-intensive for developers.

To make the tasks more economically sustainable and to avoid the complexity of selecting working pairs, the project partners were particularly interested in the viability of students being paired randomly across schools via the online environment. It was presumed there was a symmetry of status, knowledge and roles with a shared problem space.

Students were paired randomly and across schools where possible. It was technically difficult to ensure students were paired across schools and to maintain consistent pairing as students were easily able to drop out of their pairing situations. There were a small number of selected pairings as part of the cognitive interview process.

The selection process for working pairs may be varied in future trialing to investigate the effect of random pairing versus selected pairing.

Cognitive interview process

The cognitive interviews in this research activity focused on the cognitive and social skills that students used to solve the problems presented in the tasks. Information was collected on students' interaction and engagement with the four assessment tasks and in particular students' feedback about the interaction between the two students. Interviews examined the extent to which the online tasks assess knowledge and skills not easily assessed by more common testing programs. The cognitive interviews were conducted by an external consultant, Education Assessment Australia (EAA).

EAA reported that:

> Though all students interviewed used computers regularly both at home and school, the level of technological sophistication in the assessment came as a pleasant surprise to most… Their satisfaction with the collaborative aspect of the assessment was most pronounced where they had a partner who was responsive and able, and being paired with a partner who was less able or disengaged could be "frustrating"…. Chat-based communication with a partner in the form of typing was not problematic… Though not specifically designed as a measure of a student's capacity for effective micro learning, the game- or puzzle-like nature of the tasks was frequently observed to involve significant amounts of micro learning in order to complete them.
> (EAA, 2015: 12)

Micro-learning referred to in the EAA report can be considered as part of the problem-solving process described as barriers by Frensch and Funke (1995). They describe the 'givh p' Ñ

The barriers must be overcome using the available tools in the assessment. The data may provide further insights into the impact of micro learning on collaborative problem-solving.

The findings from the cognitive interviews will assist in validating the four tasks and the Australian Curriculum Collaborative Problem-solving Assessment Framework.

Student survey report

In the full trial held in October, students were asked to complete a survey before commencing the collaborative problem-solving tasks and again on completion of the four tasks. See **Appendix D** for pre- and post-survey questions and data analysis.

A preliminary analysis of responses to the student survey has been conducted. Sixty-nine per cent of students who completed the pre-survey indicated they enjoyed solving problems. Ninety-six per cent of the students agreed that it was important for students to learn to solve problems, and 71 per cent thought that it was important to work with others using an online environment. Eighty-eight per cent of students thought that working with a partner helped them to solve problems; however, 56 per cent of them said that they worked with a partner to solve problems in class.

From the post-survey, 74 per cent of students indicated they enjoyed solving the problems in the tasks, and 88 per cent of the students liked using the chat box. Unexpectedly, 82 per cent of students felt that they worked through the problems in an organised way. Over 70 per cent of students responded that they suggested ideas to their partner,

successful in solving the problems in the tasks; or whether students who felt that they had suggested ideas themselves and used the ideas of others rated h

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APPENDIX A: DRAFT AUSTRALIAN CURRICULUM ASSESSMENT FRAMEWORK FOR COLLABORATIVE PROBLEM-SOLVING

Draft Australian Curriculum Assessment Framework for Collaborative Problem-solving tasks ï Social domain							
Based on Australian Curriculum: General capability (Personal and Social Capability)							
Element	**Outcome**	**Indicator**	**Criteria (Level based on Krathwohlôs taxonomy)**				
			Level 1 **Receiving ï listening**	**Level 2** **Responding ï actively responding to**	**Level 3** **Valuing ï to support ideas**	**Level 4** **Organising ï to harmonise**	**Level 5** **Systemising ï to resolve**
Self-awareness SEA	Students assess their strengths and weaknesses	Describes their learning C (a)					

Dra	urriculum Assessment Framework for Collaborative Problem-solving tasks ï Cognitive domain						
Co	ï Critical and Creative Thinking general capability						
Ele	Outcome	Indicator	Level (1)	Level (2)	Level (3)	Level (4)	Level (5)
Inqu (CI)	udents entify, plore and ganise ormation	Pose or clarifies questions	Poses a question	Poses a relevant clarifying question	Identifies the information needed	Interprets the information provided	Explains the need for the information
		Collects and organises information (b)	Uses an element of information	Uses isolated pieces of information	Uses relevant elements of information	Uses links in relevant information from a number of	Com n mlarifying

Draft Australian Curriculum Assessment Framework for Collaborative Problem-solving tasks ï Cognitive domain							
Cognitive domain ï Critical and Creative Thinking general capability							
Element	**Outcome**	**Indicator**	**Level (1)**	**Level (2)**	**Level (3)**	**Level (4)**	**Level (5)**

APPENDIX B: SUMMARY OF THE FOUR TASKS

Task 1: Lights out

Students are provided with the following scenario: Most devices that we use every day contain electrical circuits to make them work. Sometimes they don't work properly for a variety of reasons.

Students work with their partner to identify problems and find solutions to make circuits work and keep the lights on.

Task 2: Let's tackle the fish problem

Students are provided with the following scenario: The water in the creek is polluted. Fish are dying. We believe it is the pollution that is killing the fish.

Students work with their partner to identify the condition causing the pollution and where it is coming from, so they can fix the problem.

Task 3: Who's got your vote?

Students are provided with the following scenario: Voting occurs in local settings (such as a school election for captains), at sporting clubs (for people to chair committees) and at the government level (for members of parliament including premiers and Prime Minister). In democratic elections, the winner is the candidate with the most votes. For a democratic election to be fair, all votes must be counted.

Students work with their partner to undertake different forms of voting that are commonly used in a variety of situations.

Task 4: Where the wind blows

Students are provided with the following scenario: A wind farm is a collection of wind turbines in one location. Wind power can be used to generate electricity and reduce carbon emissions. Wind turbines capture wind energy to produce electricity.

Students work with their partner to build a wind farm to supply energy to an island in the Celtic Sea.

APPENDIX C: SCORING RUBRIC FOR TASK 1 ï LIGHTS OUT

Evidence for elements and indicators for collaborative problem-solving Task 1: Lights Out

Part A: Constructing a circuit

An individual student constructs the circuit by dragging and dropping the parts to the appropriate positions. Coded as:

Self-management (SEM)						
Students set goals to work towards their achievement	**Uses self-discipline and sets goals (a) A/C**	**Takes action**	**Follows simple instructions**	**Follow complex instructions**	**Makes a plan / sets goals**	**Analyses set goals**
		Something moves to a location (SEMa1)	Drags components to correct locations –			

First use of chat box: students introduce themselves to their partner

Part C: Complex brightness settings

Students use the chat box to share information about their settings with their partner as they can only see the settings on their own switch and settings box. From this they need to determine:

i) Which settings make the lamp go on.

ii) Which settings on the settings boxes make the lamp shine brightest.

Social management (SOM)	
Coordinate and	

Cognitive ï inquiring (CI)						
Students identify, explore and organise information	**Collects and organises information (b) A**	**Uses an element of information**	**Uses isolated pieces of information**	**Uses relevant elements of information**	**Uses links in relevant information**	**Combines and uses relevant information from a number of sources**
		Changes settings for one component (CIb1)	Changes settings on all components (CIb2)	Records correct combination of settings for switches (CIb3)	Produces the brightest lamp (CIb4)	Records correct combination of settings for both components (CIb5)

Part D: Finding faults

In this part each student has two light bulbs (different), settings box and a switch. Students can drag and drop components into their section of the circuit (indicated by blue and red regions) Students need to work systematically to determine which components are faulty and which are working and drag them to the correct positions. One of the bulbs is broken for each person and either the settings box or switch.

Social management (SOM)
Coordinate and resolve potential

APPENDIX D: STUDENT SURVEY DATA ANALYSIS

Pre-survey

Student pre-survey completed prior to commencement of tasks.

Survey items	**Percentage**			
	Strongly disagree	**Disagree**	**Agree**	**Strongly agree**
It is important for students to learn ways to solve problems	2	2	53	43
Working with a partner helps me to solve problems	3	9	63	25
It is important to work with others using an online environment	3	26	64	7
I enjoy solving problems	6	25	55	14
	Rarely	**Sometimes**	**Often**	**Always**
I work with a partner to solve problems in class	6	38	47	9

Note: The percentages provided in the table are the percentage of those students who responded. 28.8 per cent of the total number of students participating did not respond to the pre-survey questions.

Post-survey

Student post-survey completed after the completion of the tasks.

Survey items	**Percentage**			
	Strongly disagree	**Disagree**	**Agree**	**Strongly agree**
I enjoyed solving the problems	8	18	59	15
I liked using the chat box	4	8	44	44
I worked through problems in an organized way	5	13	68	14
	Rarely	**Sometimes**	**Often**	**Always**
I suggested ideas to my partner to help solve the problems	6	23	46	25
I understood my partner ideas and information	7	14	43	36
I used ideas from my partner to help solve the problems	6	21	46	27
	Task 1	**Task 2**	**Task 3**	**Task 4**
Which task did you enjoy the most?	29	43	20	8
	Most interesting	**Easiest**	**Most challenging**	**Most familiar**
Why did you select this task as your favourite?	58	28	5	9

Note: Task 1: Lights out; Task 2: Let's tackle the fish problem; Task 3: Who's got your vote?; Task 4: Where the wind blows.

The percentages provided in the table are the percentage of those students who responded. 59 per cent of total number of students participating did not respond – this was in part due to a technical problem on one day when students were unable to complete and