ACTRC

Science Inquiry Skills Test: Development, Analysis and Feedback to Teachers

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The Assessment, Curriculum and Technology Research Centre is a partnership between the University of Melbourne and the University of the Philippines supported by the Australian Government.

Australian Aid

Science Inquiry Skills Test (SIST)

Purpose

- To determine the extent to which science inquiry standards are being met
- To assess Grade 8 students' science inquiry skills across a range of difficulty

Coverage

- simple measurements
- classification tasks
- control of several variables
- interpretation of multivariate data

Science Inquiry Skills Test (SIST)

Constraints

- Minimize science content knowledge, that is, to be as content-free as possible.
  - To assess the science inquiry skills of the students without interference caused by differences in knowledge of science content due to different curricula.
- Minimize the reading load.

Method

Samples

- 44 Grade 8 sections
- 11 schools
- 2 teachers per school
- 2 sections per teacher

Diverse sample of school settings in terms of

- class size
- access to resources

Science Inquiry Skills Test

- 36 multiple choice test items administered to 1769 Grade 8 students

SIST

Development process

- Definition of science inquiry
- Description of the domain
- Identification of the subskills
- Development of blueprint (Table of Specifications)
- Development of items
- Panelling (critiquing) of items
- Piloting of items in the field
- Analysis of test results
- Finalization of test

SIST

Development process

Definition of science inquiry

Five essential features of science inquiry

1. (EQ) Learner begins with a **question** that can be answered in a scientific way.
2. (EV) Learner gathers **evidence** in attempting to answer the question.
3. (EX) Learner forms an **explanation** to answer the question based on the evidence collected.
4. (EK) Learner connects explanations to scientific **knowledge**.
5. (EC) Learner **communicates** and justifies explanations.

(National Science Education Standards, 1996)

Development Process

Key Stage Standards from the K to 12 Science Curriculum

K–3	4–6	7–10	11-12
At the end of Grade 3, learners should have acquired healthful habits and have developed curiosity about self and their environment using basic process skills of observing, communicating, comparing, classifying, measuring, inferring and predicting.	At the end of Grade 6, learners should have developed the essential skills of scientific inquiry – designing simple investigations, using appropriate procedure, materials and tools to gather evidence, observing patterns, determining relationships,drawing conclusions based on evidence, and communicating ideas in varied ways ...	At the end of Grade 10, learners should have developed scientific, technological, and environmental literacy & can make rational choices on issues confronting them. …….they should recognize that the central feature of an investigation is that if one variable is changed (while controlling all others), the effect of the change on another variable can be measured.	At the end of Grade 12, the learners should have gained skills in obtaining scientific and technological information from varied sources about global issues that have impact on the country. ……They should be able to process information to get relevant data for a problem at hand.

Development Process

Test blueprint for each key stage (K-3, Gr4-6, Gr7-10, Gr11-12)

	EQ scientifically oriented questions	EV ….evidence in responding to questions	EX …explanations from evidence	EK … connects explanations to scientific knowledge	EC Communi-cates and justifies explanations
Standard					
Develop-mental progression					
Item ideas					
Number of items					

SIST

Skills section from test blueprint and

Key stage standards

Grade		Learner formulates explanations from evidence
11-12	Standard	skills in obtaining scientific and technological information from varied sources
	Developmental progression	able to reconcile evidence from multiple sources
7-10	Standard	the effect of the change on another variable can be measured
	Developmental progression	able to interpret quantitative data and to formulate scientific explanations in terms of associations and cause and effect
4-6	Standard	observing patterns, determining relationships, drawing conclusions based on evidence
	Developmental progression	able to interpret measurements and explain findings of empirical investigations based on reason
K-3	Standard	comparing, classifying inferring and predicting
	Developmental progression	able to describe observations and measurements made

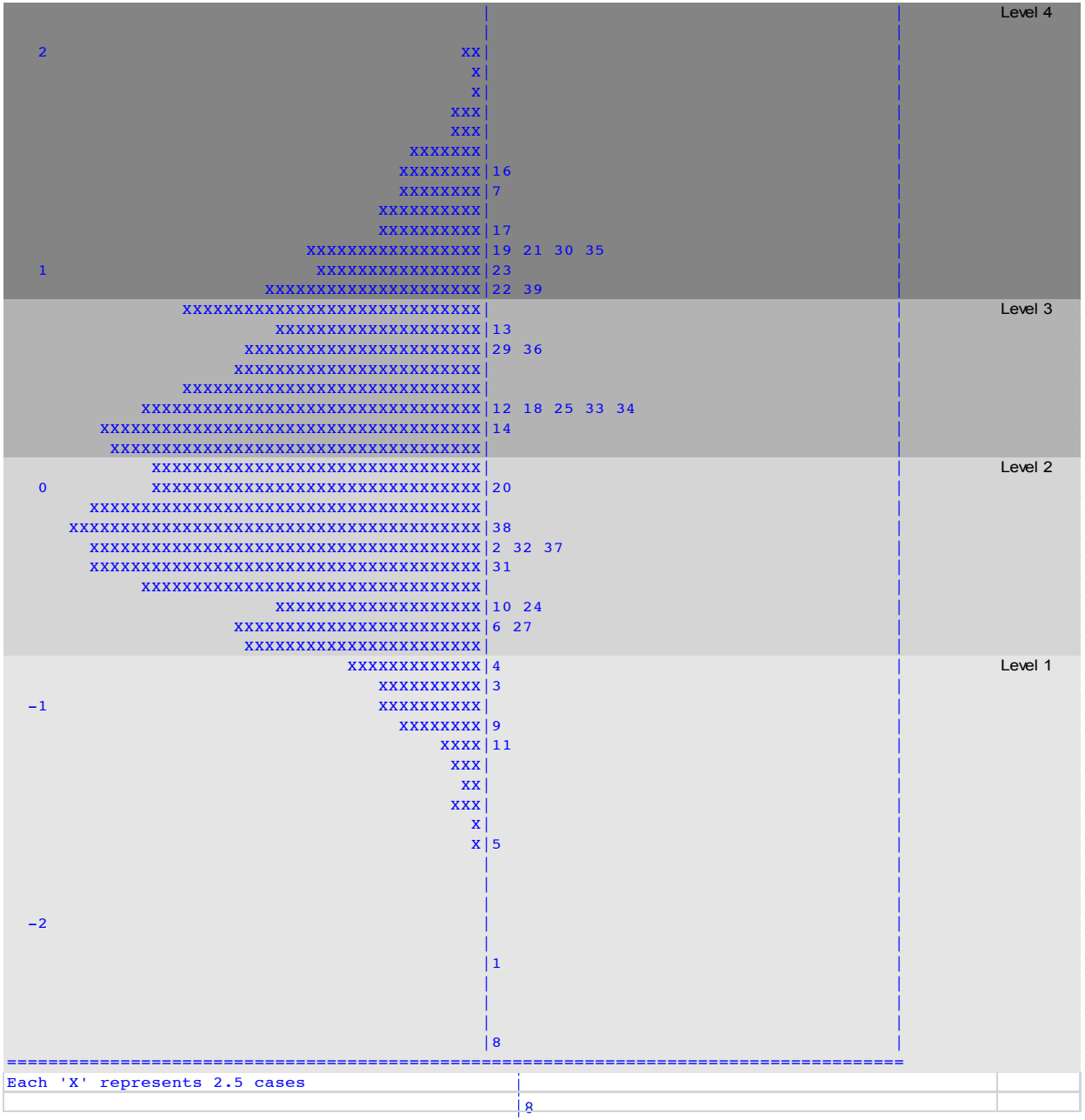
Analysis of Data

- Item Response Theory was used to determine students' ability estimates using ConQuest (Adams, et al,. 2012).

- The statistical characteristics of the test indicated that it is sampling a clear construct and has the capacity to differentiate between students – good basis for establishing both validity and reliability.

SIST

Item-person map showing the relative difficulty of science inquiry skills



Feedback to Teachers

- Results given to a teacher describe the performance of only the two classes handled by the teacher. The data should not be construed as a reflection of general school performance.

- Results are not expressed as numeric scores but in terms of students' **emerging abilities**—the levels at which they are ready to learn a particular set of science inquiry skills.

Feedback to teachers

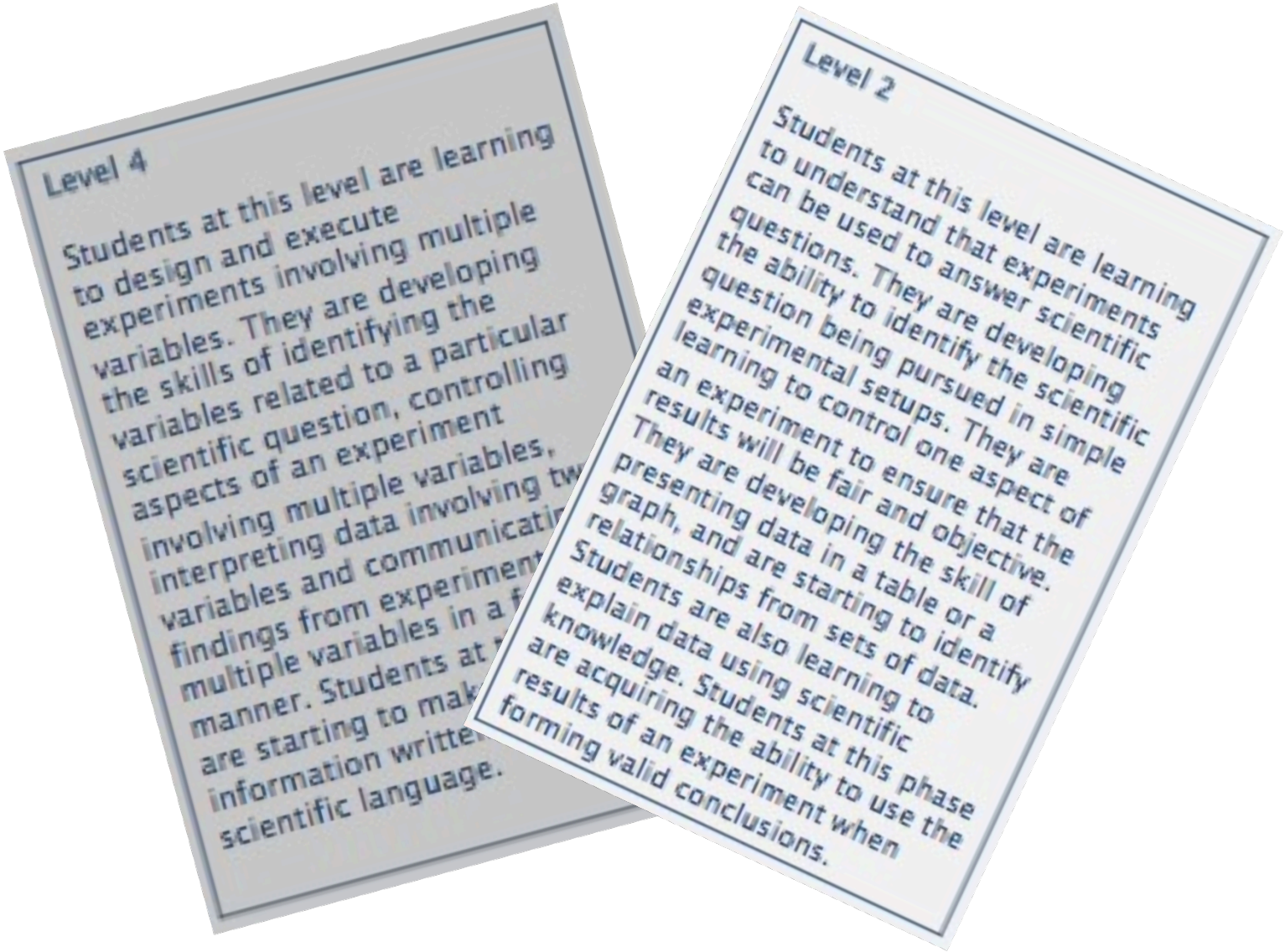
Developmental progression of science inquiry skills

- Skills in each level build on those in the previous levels.
- Each level description is an indication of the kinds of ideas those students are ready to engage in.

Levels	
4	Ability to experiment with multiple variables
3	Ability to relate answers to current scientific knowledge
2	Ability to answer questions using results from scientific inquiries
1	Ability to measure, observe and classify

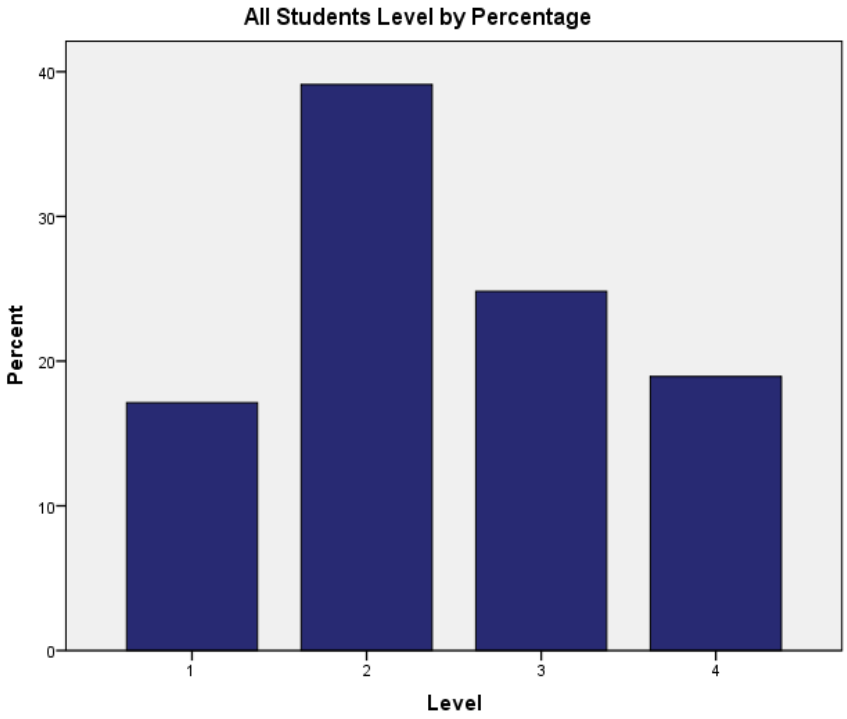
Feedback to teachers

Developmental progression of science inquiry skills - examples



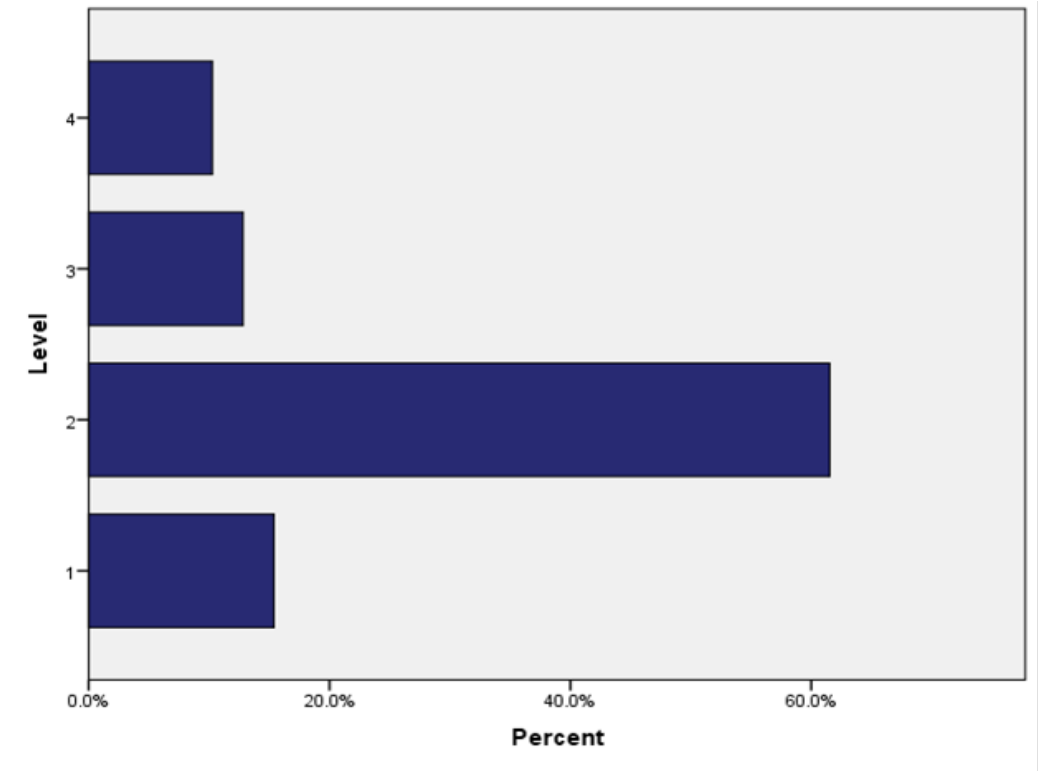
SIST

Student results from test pilot



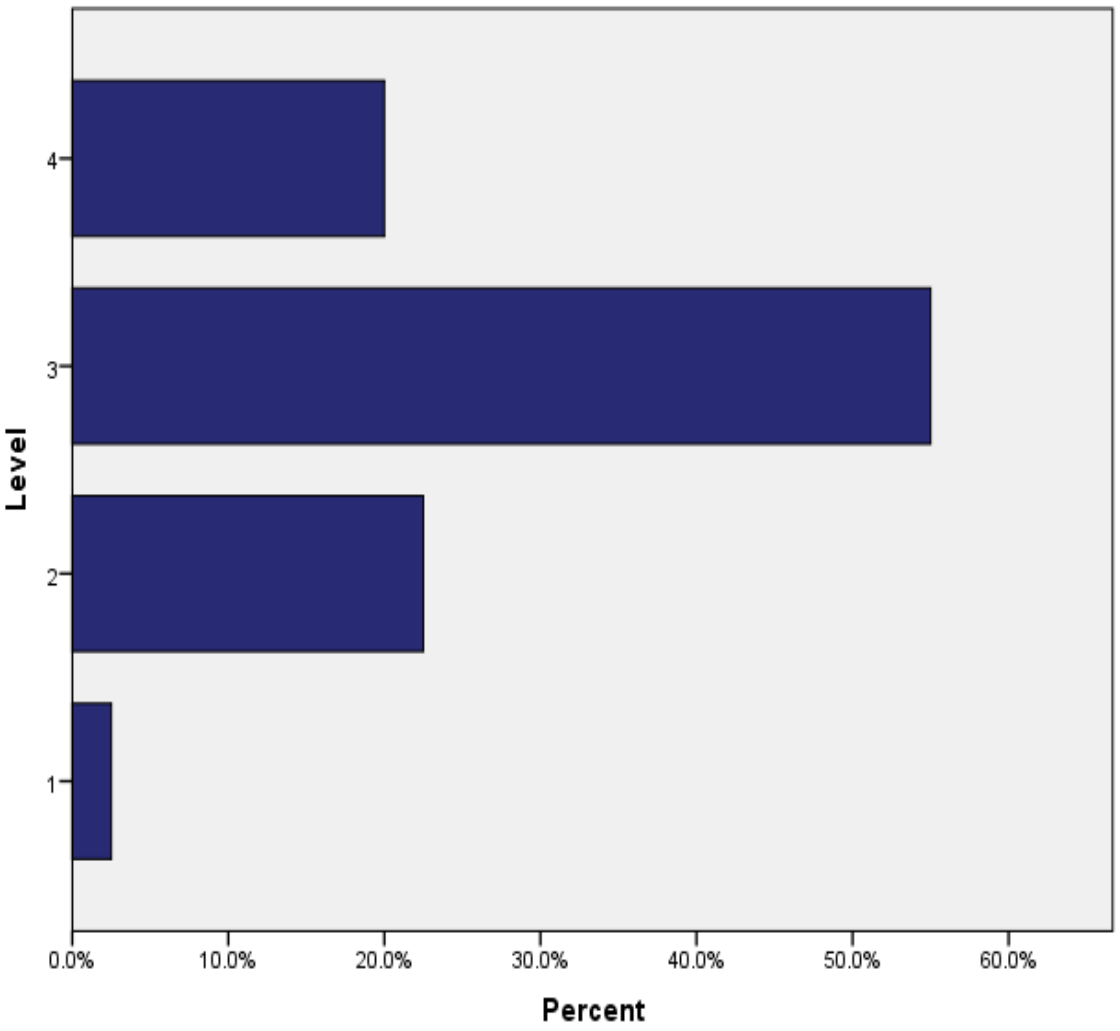
SIST

Student results from one class



SIST

Student results from another class



Level 1 Sample

Angela wants to know at what temperature ice cream melts. Which of the following instruments could she use in her investigation?

A. balance
B. microscope
C. stopwatch
D. **thermometer**

Level 4 Sample

Michelle wants to know if the growth of pot plants is affected by soil pH. Which of the following will be the focus of her investigation?

A. pot size and shape
B. air temperature and soil pH
C. kind of plant in the pot
D. **plant height and soil pH**

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