Scientific Studies

2011 Assessment Report

Government of South Australia

SACE Board of SA

SCIENTIFIC STUDIES

2011 ASSESSMENT REPORT

OVERVIEW

Assessment reports give an overview of how students performed in their school and external assessments in relation to the learning requirements, assessment design criteria, and performance standards set out in the relevant subject outline. They provide information and advice regarding the assessment types, the application of the performance standards in school and external assessments, the quality of student performance, and any relevant statistical information.

SCHOOL-BASED ASSESSMENT

Assessment Type 1: Investigations Folio

Issues Investigations

There were some excellent issues investigations that demonstrated incisive thinking and reflected good teaching. Common to these high quality investigations are, firstly, the selection of an appropriate issue and, secondly, the support of teachers to assist students to formulate a relevant question that can be investigated deeply from two opposing points of view.

In the more successful investigations students gathered information from a range of sources, including textbooks, journals, guest speakers, or interviews. The information was then analysed and critiqued for relevance and scientific accuracy, before the students stated and explained their own conclusions. It was clear in the excellent investigations how the students had formulated their conclusions, as these linked closely to the weight and accuracy of evidence presented for the argument.

Evidence of best practice also included:

- an easy-to-follow task sheet that identified the specific features of the assessment design criteria being assessed in the task and clearly outlined the assessment conditions (including timelines) to support the students
- a choice in the format for presentation
- adhering to the word-count or time-limit as prescribed in the subject outline
- referencing all sources of information in an accurate bibliography
- the use of subheadings to support students' organisation of ideas
- the use of verification processes to prevent plagiarism.

It was evident in investigations where the identified issue was broad that students found it difficult to select, analyse, and evaluate appropriate information effectively within the prescribed word-count.

Teachers are encouraged to continue to support students in developing their skills in referencing, while students are reminded that relying heavily on the Internet for information can easily lead to plagiarism.

Practical Investigations

Practical investigations were generally interesting and engaging, and provided students with a range of opportunities to display evidence of each of the assessed specific features of the assessment design criteria.

Within practical activities, there is to be at least one opportunity for students to design their own practical investigation. The most successful design practical investigations were supported by a detailed task sheet clearly outlining the steps involved in conducting and evaluating a practical investigation, including assessing and providing feedback on the design prior to the commencement of the actual investigation. Without feedback on practical design, students may not be able to conduct appropriate investigations.

It was noted that some students did not demonstrate a clear understanding of:

- the appropriate conventions and formats for the presentation of data in tables and graphs
- systematic and random errors
- how to analyse and evaluate data and procedures, including the correct use of terms such as ‘accuracy’ and ‘reliability’.

Developing these skills in formative work prior to assessments is crucial for student success.

While moderators appreciate the difficulty in providing evidence for the assessment of the manipulation of apparatus and technological tools to implement safe and ethical investigations, some effective examples seen at moderation included: teacher notes accompanied by a student reflection; peer assessment; teacher checklists with student reflection; and annotated photographic evidence with or without student reflection.

Assessment Type 2: Skills and Applications Tasks

The range of tasks used in this assessment type clearly showed that teachers are using a variety of strategies and assessments to engage students and to support them in providing their best evidence of learning.

The best student evidence was supported by a set of tasks that provided students with:

- clear guidelines on the types of assessment
- a small number of specific features for each individual assessment, while covering all specific features across the set of assessments
- scaffolding within tasks to encourage evidence of highest level of the performance standards, such as questions asking students to explain or evaluate
- variety and flexibility in the format for presentation of evidence
- suggested timelines for completion of tasks, incorporating opportunities for feedback.

Evidence for collaborative work should be provided and examples presented in student evidence included peer evaluation, self-evaluation, teacher comment, or a combination of these. It was often difficult to ascertain where in the set of assessments collaboration was being assessed.

It is also imperative when students are working collaboratively that evidence of each individual student's work is provided in the students' sample. For example, in a group oral presentation, each student should provide evidence of his or her own contribution along with the group product, such as the student's cue cards, copies of PowerPoint slides, or a video or audio of the presentation.

Teachers are encouraged to continue to work with students to develop their skills in analysing and evaluating data in formative tasks.

EXTERNAL ASSESSMENT

Assessment Type 3: Practical Investigation

Students were inventive and innovative with their selections for the extended practical investigation that forms the external assessment, with many of the investigations showing an excellent grasp of the scientific method.

The practical investigation is marked by the student's teacher and also by a trained SACE Board marker. The two sets of marks are then combined to give the student their final grade for the assessment component.

Preferably, differences between teacher marks and the SACE Board marks are small but systematic errors, such as where teachers misinterpret the criteria in the subject outline, can be avoided. Teachers are urged to carefully read the assessment design criteria in the subject outline along with the performance standards and use them carefully in assigning student grades.

Students who understand the assessment design criteria and performance standards used to assess this task are likely to present better investigations than those who do not.

Selection of a suitable investigation is paramount to student success in this assessment component. Investigations which are defined by hypotheses that are either too simplistic or too involved limit students' ability to analyse the procedure and results in appropriate depth.

Ideally, the investigation is interesting and relevant to the student and requires the student to develop a challenging, but not too demanding, method.

In schools where student choice of investigation topic and hypothesis was restricted, reports that were very similar in content and style were produced. It is imperative to safeguard against plagiarism and collusion if using this format. Students are encouraged to develop diverse hypotheses.

The examples of best practice for this assessment type were when students were clearly allocated appropriate time to design, conduct, and evaluate the investigations, the investigations were cognitively challenging for the students, and it was evident that formative tasks in the investigation process had occurred so that students were confident in their evaluative skills. Investigations where the practical was too simplistic restricted the opportunity for students to provide evidence of analysis and evaluation.

Teachers are reminded that practical investigations require a suitable sample size to reduce the effects of random errors and therefore verify results. Where possible, students are also encouraged to repeat their practical. It was noted that many students performed their investigation once only and/or had relatively small sample sizes.

Proposal

The proposal includes a statement of an investigable question or hypothesis, the identification of variables, and an outline of the proposed research approach and method. The proposal is assessed prior to the student completing the investigation.

The assessed proposal, including teacher feedback, is submitted with the completed report. Proposals where students had responded to teacher feedback and incorporated teacher suggestions into their design produced the best evidence for assessment. Teachers are reminded that rewriting parts of a student's proposal may, in effect, result in plagiarism, if the rewritten work is subsequently incorporated into the final report. Teachers are encouraged to provide feedback, in the form of guiding questions and suggestions only, and not to rewrite a student's work.

Although support materials suggest a word-count of approximately 500 words for the proposal, it is not a prescribed word-count. In some instances, students included information here that would have been more appropriate in the discussion part of the investigation report.

In a small number of cases it was difficult to ascertain specific information, such as whether:

- the proposal had been sighted by the teacher
- the student responded to feedback or independently initiated change
- a proposal had been submitted at all, as some investigations contained obvious design errors, which then penalises students.

Report of the Investigation

Hypothesis

A hypothesis is a testable statement of predicted results, which links the dependent and independent variables. It is not a question. For example, 'Boys are taller than girls' is a hypothesis, whereas 'Are boys taller than girls?' is a question, not a hypothesis. Students with clear, testable hypotheses usually found it easier to prepare a successful investigation.

Evidence of poorly worded hypotheses that failed to link the independent variable with the dependent variable was noted. Some students did not know the difference between these two variables, while others proposed to test two independent variables.

Method

Evidence presented by students ranged from simplistic to very complex methods. Writing this section succinctly, while including all relevant detail, provides students with the best evidence of the investigation assessment design criteria. Explicit teaching of this genre of writing assists students to be successful.

The best methods included in their evidence:

- an accurate description of the number or size of apparatus
- the number and time span of various procedures within the method
- repeating the procedure
- describing exactly what was to be measured and how this would be recorded
- appropriate sample sizes for reliable results to be recorded
- a simple, labelled diagram to help explain the method.

A well-written, clear method is one that can be followed and carried out by Year 8 students.

Results

It is important that all tables and graphs have appropriate labelling, including title, axes, and units.

- In a table, the independent variable is usually across the top.
- In a graph, the independent variable is almost always on the horizontal (x) axis, and the dependent variable is on the vertical (y) axis.

In presenting data, a summary results table which includes all of the raw data in a single table provided the best evidence of the fourth specific feature of the investigation assessment design criterion (I4 in the subject outline). From the summary table, a summary graph can be drawn. Not all experiments make it easy to summarise data, but every effort should be made to simplify the final set of results. The summary table or graph can then be easily used to analyse the data and prepare a conclusion.

A line graph should be used for continuous data and a bar or column graph for discrete data. Continuous data can be interpolated (for example, it is possible to measure between 3 and 4 seconds), but discrete data is disconnected (for example, apple and oranges).

A few students presented only qualitative data (such as digital photos or drawings), instead of quantitative data, resulting in a lack of evidence for data analysis.

Discussion

Evidence showing clear, logical, and sequential presentation of ideas gained the best scores. This was particularly relevant in the evaluation section of the report.

The accurate use of scientific terms is expected and explicit teaching of terms is recommended.

- The term ‘accuracy’ is poorly understood. The accuracy of an experimental value indicates how close the result is to the true value and depends on the extent to which systematic errors are minimised. Students commonly discussed accuracy in terms of deficiencies in their equipment rather than the accuracy of the actual measurements.

- Students are encouraged to use the terms ‘precision’, and ‘resolution’, but it is not a requirement. Measurements are more precise when there is less scatter in the results. A range column in a data table can be useful for determining precision. The resolution of a measuring instrument is the smallest increment measurable by the measuring instrument.

- Students are required to identify sources of error and both *random* and *systematic* errors. Increasing the number of measurements (increasing sample size) minimises the effects of random errors and increases the reliability of the data. Systematic errors are present when measured values differ consistently from the true value. Systematic errors can be identified and results verified by repeating an experiment, and using an alternative source of equipment and materials.

Conclusion

The conclusion should relate the original hypothesis to the findings. A statement claiming whether or not the hypothesis was supported by experimental evidence is highly recommended. Students could also potentially rewrite the hypothesis to accommodate the experimental findings.

Teachers and students should note that a hypothesis cannot be 'proven', but can be 'supported' by experimental evidence. A hypothesis can, however, be disproved by contrary evidence.

OPERATIONAL ADVICE

School Assessment

Teachers are asked to ensure that the addendum section of the learning and assessment plan is used to record any changes made to the approved learning and assessment plan, including task changes or changes to the criteria being assessed in each task. These changes may be for an individual student or for the entire class.

Packaging of materials for moderation was generally as prescribed in the learning area manual. Moderators commented on the quality of teaching packages that included:

- a copy of the approved learning and assessment plan, with addendum if necessary
- a complete set of task sheets, with solutions where appropriate
- a completed Variations in Materials for the Sample for Final Moderation form.

The Variations in Materials for the Sample for Final Moderation form provides vital information on any anomalies that may be present in the samples requested for moderation. Teachers are to record valid reasons for any missing evidence, breaches of rules such as plagiarism or exceeding word-count, and the penalties that were applied in any such cases.

External Assessment

Each practical investigation is identified using the student's SACE registration number only. Any reference to either the school or the student in the body of the report should be removed.

A clear proposal is also necessary and this should be easily identified from the final report. Teacher marks and comments should not appear on any part of the report submitted for external assessment.

The vast majority of students successfully completed the investigation within the word-count. Students who exceeded the word-count tended to have extra sections not required by the criteria. Long introductions, and reviews of literature, are outside the requirements of this component.

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