Scientific Studies

2012 Chief Assessor's Report

Government of South Australia

SACE Board of SA

SCIENTIFIC STUDIES

2012 CHIEF ASSESSOR'S REPORT

OVERVIEW

Chief Assessors' 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 ASSESSMENT

Assessment Type 1: Investigations Folio

Issues Investigations

Some of the student responses in this section were excellent and reflected some good preparation and support by the teachers. The key support was with regard to the appropriate choice of an issue that enabled the student to investigate relevant opposing points of view. Good responses included a thorough explanation of the science behind the issue, followed by a clear explanation of both sides of the issue, and many students were able to explain their personal view on the issues with reasons. In the more successful responses, students selected and referred to information from a wide range of sources which were referred to appropriately in the text of their report. They also included their sources in a well-constructed bibliography and evaluated some of their sources for bias, credibility, accuracy, and suitability. Some students demonstrated a poor ability to evaluate sources, with general comments that did not relate to the sources or the issue being discussed.

Evidence of best practice also included:

- a well-designed task sheet that identified the specific features of the task, as well as clearly outlining the assessment conditions, including word-limit or time allowed according to the subject outline
- support by teachers to help students develop the ability to critically select and evaluate information
- teachers providing feedback to students on a draft, which also assisted with the application of the supervision and verification policy
- use of headings, which assisted the students with the organisation of their ideas.

Teachers are also encouraged to provide students with formative issues tasks in order to be able to give effective feedback that will prepare them for their summative issues task.

Practical Investigations

A wide range of practical activities were completed that enabled students to show evidence of the specific features in all assessment design criteria while also fulfilling the requirements for practical investigations as stated in the subject outline.

In the more successful investigations, students:

- conducted valid experiments that included replication to increase the reliability of their data
- included appropriate calculations and clearly labelled tables and graphs, selected to appropriately display the data that was collected
- provided scientific explanations that connected their data to the relevant scientific concepts
- included detailed evaluation of experimental design — potential sources of random and systematic errors were discussed, including how these errors could affect their results; strengths and weaknesses of the experimental design were analysed and some appropriate improvements for further research were suggested.

Evidence of best practice included:

- submission of design proposals for teacher feedback before the actual practical activity — this allows students to potentially collect better data (it is also useful for the moderation process if the assessed design proposal is included with the final report)
- provision of some scaffolding that assisted the students with the organisation of their reports — in particular, students need direction in the analysis of their data and experimental technique
- inclusion of some evidence for the assessment of specific features I3 and A3 — this included checklists completed by the teacher, photographs, and students' reflection on their work in the laboratory and group work.

Evidence suggests that many students lack a clear understanding of:

- the appropriate conventions and formats for the presentation of data in tables and graphs
- concepts such as accuracy, reliability, and validity that relate to the analysis of both the data collected and the experimental design
- the significance of random and systematic errors — many students are able to correctly define these errors, but without demonstrating an understanding of their impact on the reliability of their conclusions.

Teachers are encouraged to provide formative practical activities so that students can receive meaningful feedback to prepare reports for the practical investigations.

Assessment Type 2: Skills and Applications Tasks

A wide range of tasks were used in this assessment type, with students given the opportunity to engage in interesting and engaging activities where they were able to readily provide evidence of their learning.

Evidence of best practice included:

- tasks that addressed a small number of the assessment design criteria while covering all specific features across the set of assessments
- task sheets that clearly set out the design features of the task and provided appropriate scaffolding to assist the students with the organisation of their work
- provision of feedback to the students using the appropriate drafting process
- encouragement of students to explore a range of ways of presenting their learning, both individually as well as in collaboration with other students
- opportunities for students to perform at all levels of the performance standards, including the highest level — this means requiring students to demonstrate analytical and evaluation skills in familiar and unfamiliar contexts.

Where group work is undertaken, evidence such as videos of presentations or copies of notes or PowerPoint slides, should be provided. Students should be encouraged to provide some individual reflection on the group process, as well as providing evidence of their role in the overall process.

Task design must provide opportunities for students to demonstrate achievement at the A level of the performance standards across all of the assessment design criteria. Some students may benefit from formative opportunities to practise analysis and evaluation of data. Weightings for individual tasks in an assessment type are not required.

EXTERNAL ASSESSMENT

Assessment Type 3: Practical Investigation

The practical investigation is an extended experiment of the student's own choice. Some students were inventive and innovative with their selections. Many of the investigations showed an excellent grasp of the scientific method.

Teachers are urged to carefully read the assessment design criteria and the performance standards in the subject outline, and use them carefully in assigning grades to students. Task sheets where the specific features were clearly stated helped students to complete their reports appropriately.

Choice of topic was a problem for some students. The majority of students carried out good experiments, but some experiments that were too simplistic or too complex produced data that was difficult to analyse in depth. Ideally, the experiment reveals something of interest and relevance to the student and involves a challenging, but not too demanding, method. Simplistic hypotheses do not allow the students to demonstrate their skill in analysing data. Students are encouraged to develop diverse hypotheses. Teachers may set some parameters for the investigation, but should be careful not to restrict student choice too much, as this can produce investigations with similar results and in a similar style, so that little discrimination between students is demonstrated.

It was evident from some investigations that not all students had been given enough time to conduct a thorough investigation and then complete a detailed report. Formative work is expected to underpin the practical investigation. Investigations undertaken are expected to be of an appropriate standard for Stage 2 and a significant number of investigations were not up to this standard.

In a number of cases it was evident that significant emphasis was placed on producing the written report rather than conducting the practical, and sometimes students' reports suffered as they had too little that they could say about their inadequate set of results. It was noted that many students performed their investigation once only, while others had relatively small sample sizes.

Proposal

The task sheet given to students should clearly indicate the requirements for the proposal as described in the subject outline. These include the hypothesis, the variables, and the method. They do not include an introduction to the topic.

Teacher feedback on a student's proposal is expected and it was pleasing to sight this feedback on the original proposal and subsequently see that the student had modified their investigation design accordingly within the final report. However, it was inappropriate where the teacher extensively rewrote much of the students' work which students then reproduced within their final report. Teachers are encouraged to provide feedback and suggestions only, not to rewrite students' work.

The original proposal with feedback should be submitted attached to, but clearly separate from, the final report. The proposal provides the evidence required to assess the I1 specific feature. In a small number of cases, proposals had no feedback attached. In some other cases, the proposal was identical to the final version in the report and it was unclear whether the original proposal had been commented upon by the teacher or was an adjusted copy of the original proposal.

For a small number of investigations, no proposals were attached. It is unclear whether proposals were ever prepared, as some reports contained crucial design errors that should have had feedback. If a student receives a low grade for the I1 specific feature for their proposal, they should not be penalised from a lack of opportunity to improve their method before they start collecting data.

Investigation

Evidence was noted of poorly worded hypotheses that failed to link the independent variable with the dependent variable. Some students did not know the difference between these two variables. Others proposed to test two independent variables within their investigation when only one was needed. Students with clear, testable hypotheses, and not simply questions, usually found it easier to prepare a satisfactory method.

The ability to write a succinct method is a skill that comes with practice. Some students provided very little detail in their method, while others wrote exceptionally detailed methods. Students are encouraged to include enough detail in their procedure — such as size and number of pieces of equipment, the time taken to obtain measurements, and the number of repetitions — so that others could replicate the procedure. Too many students concluded their method with instructions like 'measure and record results', rather than specifying exactly what was to be measured and how, and sample sizes were often too small for reliable results to be recorded.

It is important that all tables and graphs have appropriate labelling, including title, axes, and units. Tables and graphs of average results, rather than all the raw data,

are more appropriate. Students who obtained qualitative rather than quantitative data often found data analysis difficult.

Students should be encouraged to use scientific terms correctly. Terms such as *accuracy*, *precision*, *reliability* and *resolution*, which are defined in the key ideas of the 'Skills' section in the subject outline, were poorly understood. Almost all students discussed accuracy in terms of deficiencies in their equipment rather than the accuracy of the actual measurements. Including the range of results in a data table is a good method of indicating the precision of the results. Students may benefit from more practice at identifying and discussing random and systematic errors and their effects on the results of an investigation.

Some students discussed how the significance of their findings could be applied to the real world. This is not an assessable component of this assessment type and these students could have used their word-limit to greater effect in the analysis and evaluation of results.

The conclusion should relate back to the original hypothesis. A statement claiming whether or not the hypothesis was supported is highly recommended. Students could also potentially rewrite the hypothesis to accommodate the experimental findings. Students should realise that a hypothesis cannot be *proven*, but can be *supported* by experimental evidence. A hypothesis can, however, be disproved by contrary evidence.

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. Teachers and students should be aware of the SACE word-count policy that any writing past the word-limit is not assessed.

OPERATIONAL ADVICE

Teachers must complete an addendum to highlight tasks that have been altered from the original learning and assessment plan, and provide a description of the changes. The addendum should indicate whether the changes are for all students or for individuals. A Variations — Moderation Materials form must be completed for students with incomplete sets of tasks or tasks that are different from the rest of the assessment group.

Where students have been given special provisions by their school for incomplete work, the variations to assessment need to be plainly articulated on the Variations — Moderation Materials form so that it is clear what the variations are, what the reasons are, and what action has been taken by the teacher.

Student work submitted for external assessment (the practical investigation) should have only students' SACE registration numbers and school numbers, with no reference to student or school names, as stated in the subject operational information under 'Preparing and Collecting Materials for External Assessment'. Markers should not be able to identify individual students or schools. Teachers' marks and comments should not appear on any part of the report submitted for external assessment.

GENERAL COMMENTS

It was pleasing to note that many programs have been tailored to the students' needs and interests. In some cases, however, the task design needs to be improved to provide opportunities for students to achieve at an A level across the specific features.

Chief Assessor
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