

Marine Science subject report

2022 cohort

February 2023



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Introduction

Throughout 2022, schools and the QCAA worked together to further consolidate the new Queensland Certificate of Education (QCE) system. The familiar challenges of flood disruption and pandemic restrictions were managed, and the system continued to mature regardless.

We have now accumulated three years of assessment information, and our growing experience of the new system is helping us to deliver more authentic learning experiences for students. An independent evaluation will commence in 2023 so that we can better understand how well the system is achieving its goals and, as required, make strategic improvements. The subject reports are a good example of what is available for the evaluators to use in their research.

This report analyses the summative assessment cycle for the past year — from endorsing internal assessment instruments to confirming internal assessment marks, and marking external assessment. It also gives readers information about:

- how schools have applied syllabus objectives in the design and marking of internal assessments
- how syllabus objectives have been applied in the marking of external assessments
- patterns of student achievement.

The report promotes continuous improvement by:

- identifying effective practices in the design and marking of valid, accessible and reliable assessments
- recommending where and how to enhance the design and marking of valid, accessible and reliable assessment instruments
- providing examples, including those that demonstrate best practice.

Schools are encouraged to reflect on the effective practices identified for each assessment, consider the recommendations to strengthen assessment design and explore the authentic student work samples provided.

Audience and use

This report should be read by school leaders, subject leaders and teachers to:

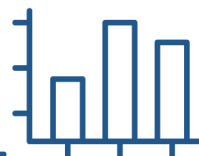
- inform teaching and learning and assessment preparation
- assist in assessment design practice
- assist in making assessment decisions
- help prepare students for external assessment.

The report is publicly available to promote transparency and accountability. Students, parents, community members and other education stakeholders can use it to learn about the assessment practices and outcomes for General subjects (including alternative sequences (AS) and Senior External Examination (SEE) subjects, where relevant) and General (Extension) subjects.

Report preparation

The report includes analyses of data and other information from endorsement, confirmation and external assessment processes. It also includes advice from the chief confirmer, chief endorser and chief marker, developed in consultation with and support from QCAA subject matter experts.

Subject data summary



Subject completion

The following data includes students who completed the General subject.

Note: All data is correct as at 31 January 2023. Where percentages are provided, these are rounded to two decimal places and, therefore, may not add up to 100%.

Number of schools that offered the subject: 48.

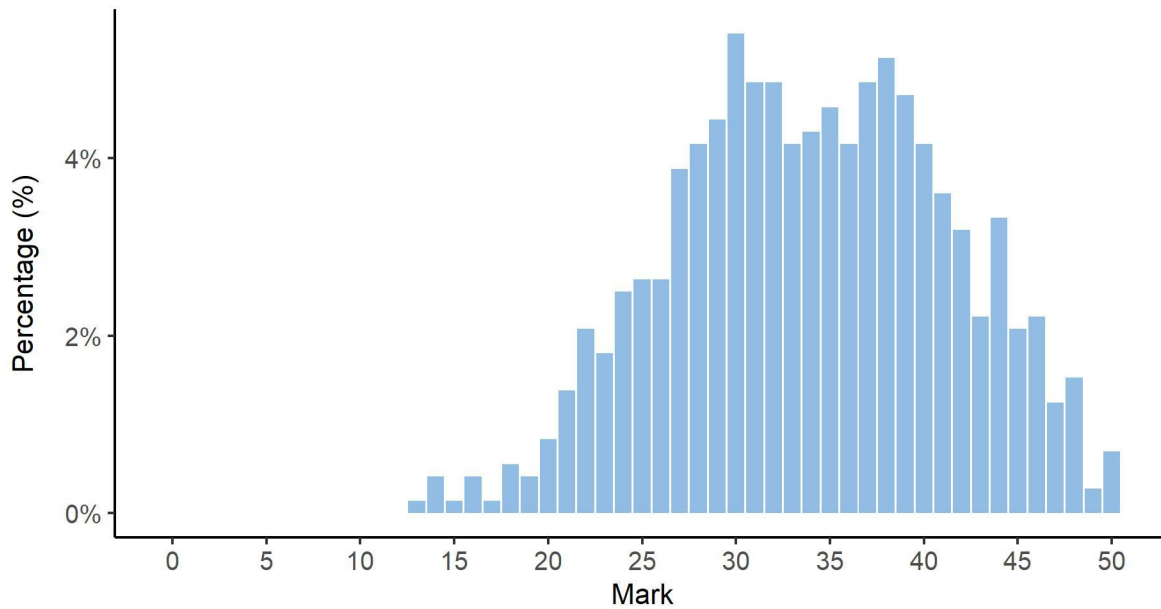
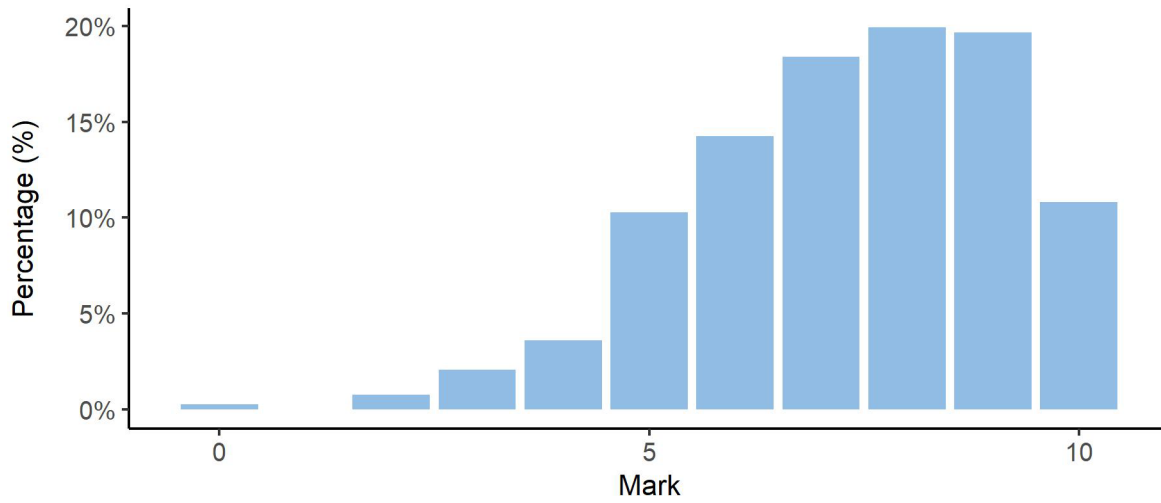
Completion of units	Unit 1	Unit 2	Units 3 and 4
Number of students completed	887	848	717

Units 1 and 2 results

Number of students	Satisfactory	Unsatisfactory
Unit 1	812	75
Unit 2	783	65

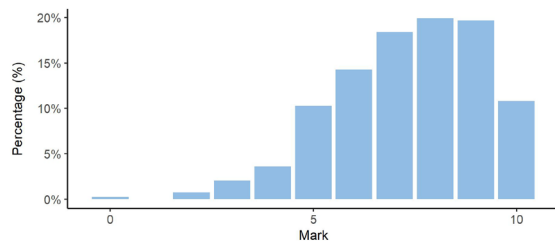
Units 3 and 4 internal assessment (IA) results

Total marks for IA

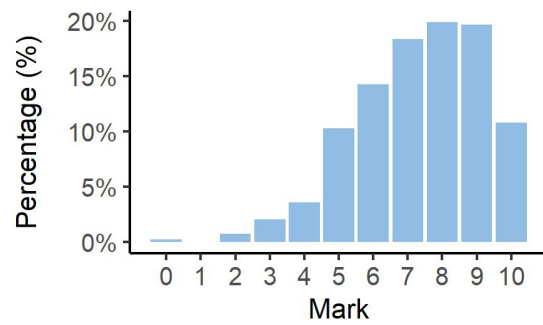


IA1 marks

IA1 total

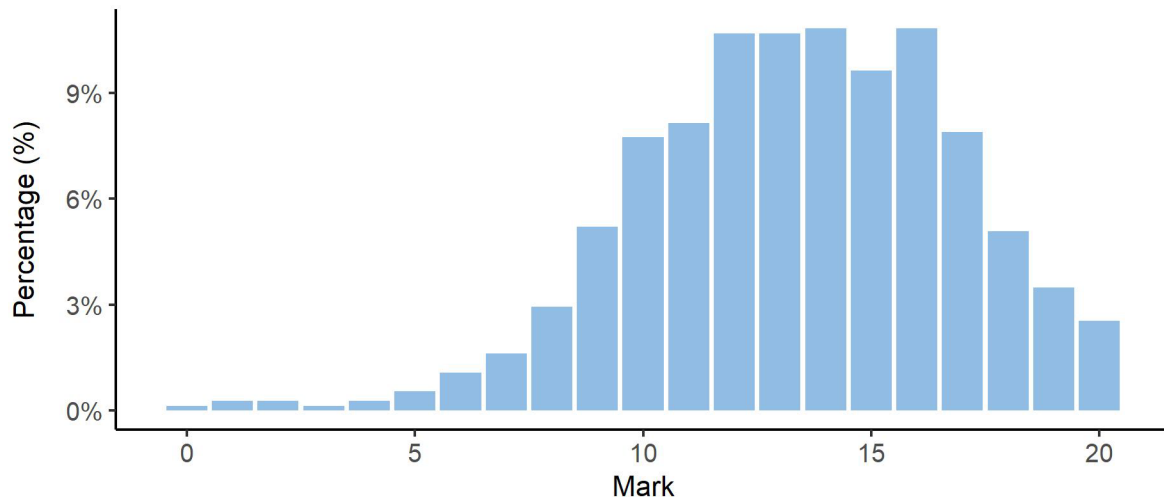


IA1 Criterion: Data test

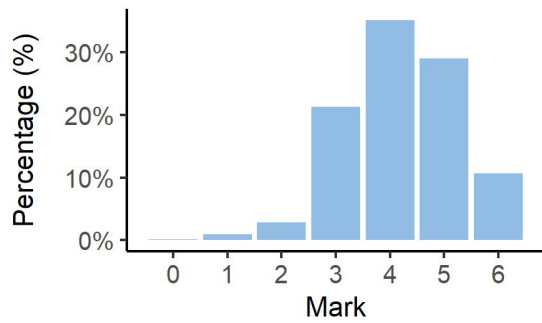


IA2 marks

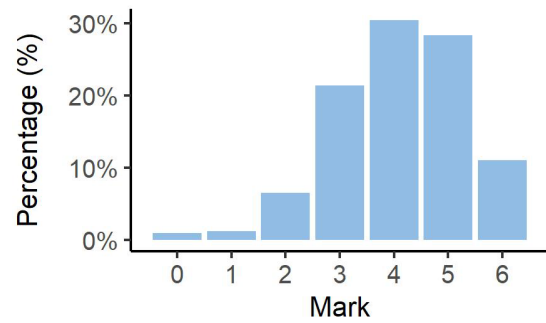
IA2 total



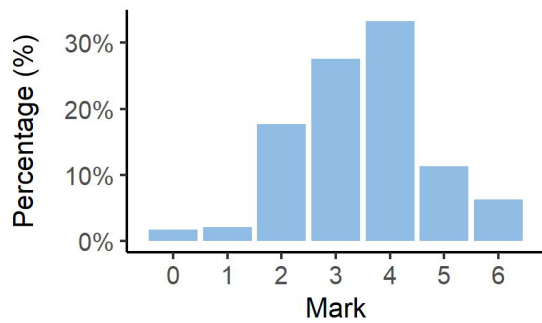
IA2 Criterion: Research and planning



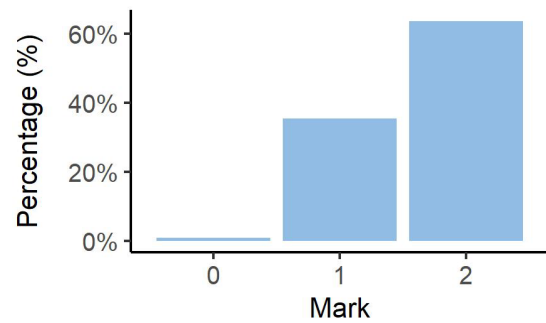
IA2 Criterion: Analysis of evidence



IA2 Criterion: Interpretation and evaluation

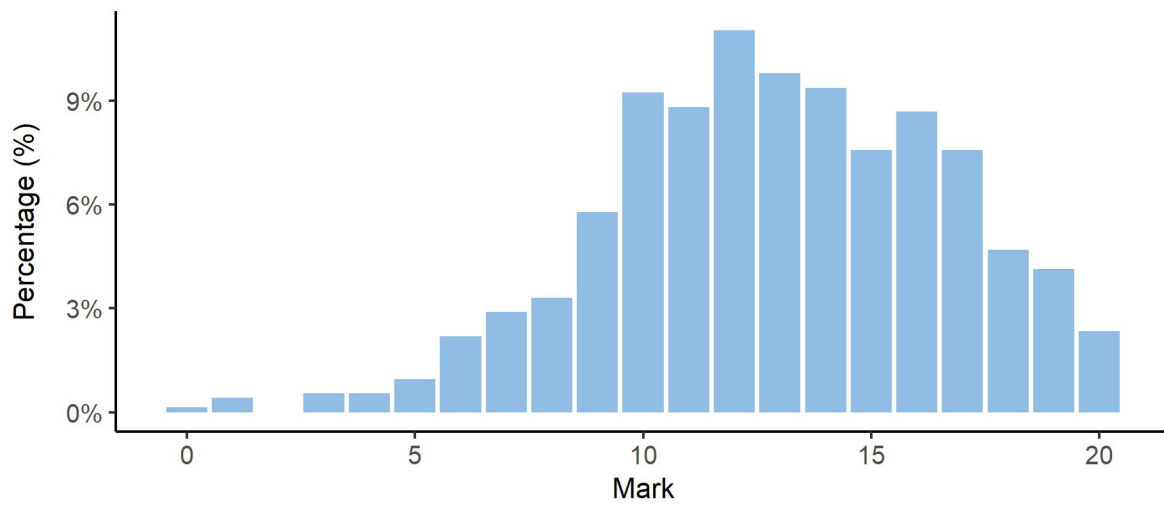


IA2 Criterion: Communication

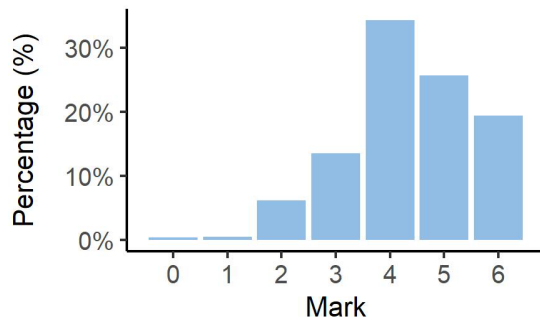


IA3 marks

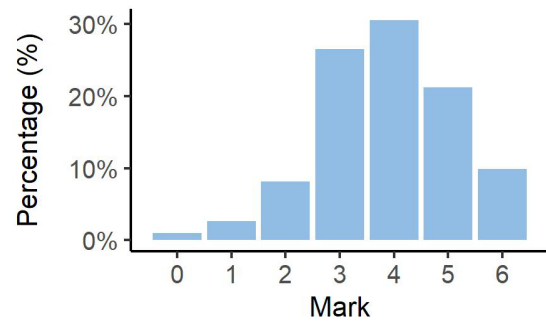
IA3 total



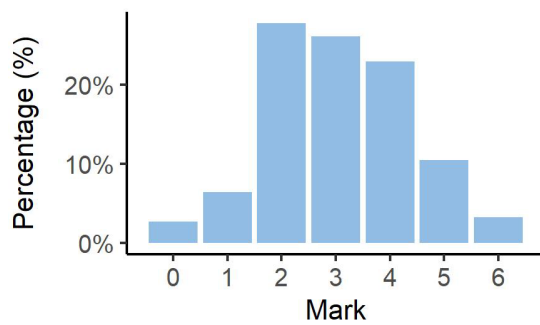
IA3 Criterion: Research and planning



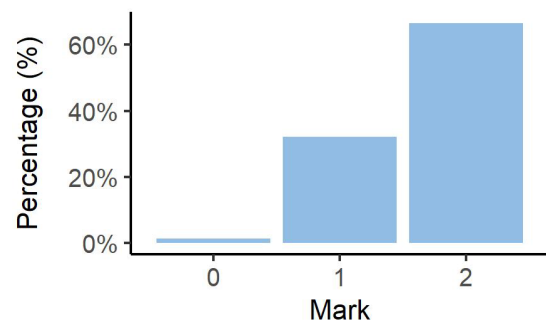
IA3 Criterion: Analysis and interpretation



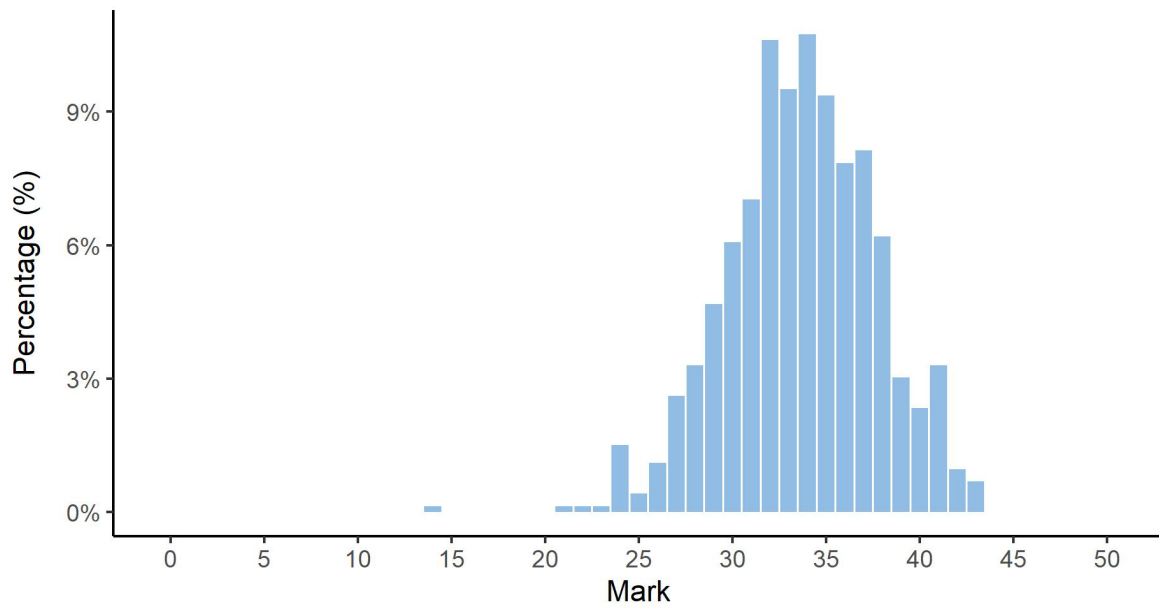
IA3 Criterion: Conclusion and evaluation



IA3 Criterion: Communication

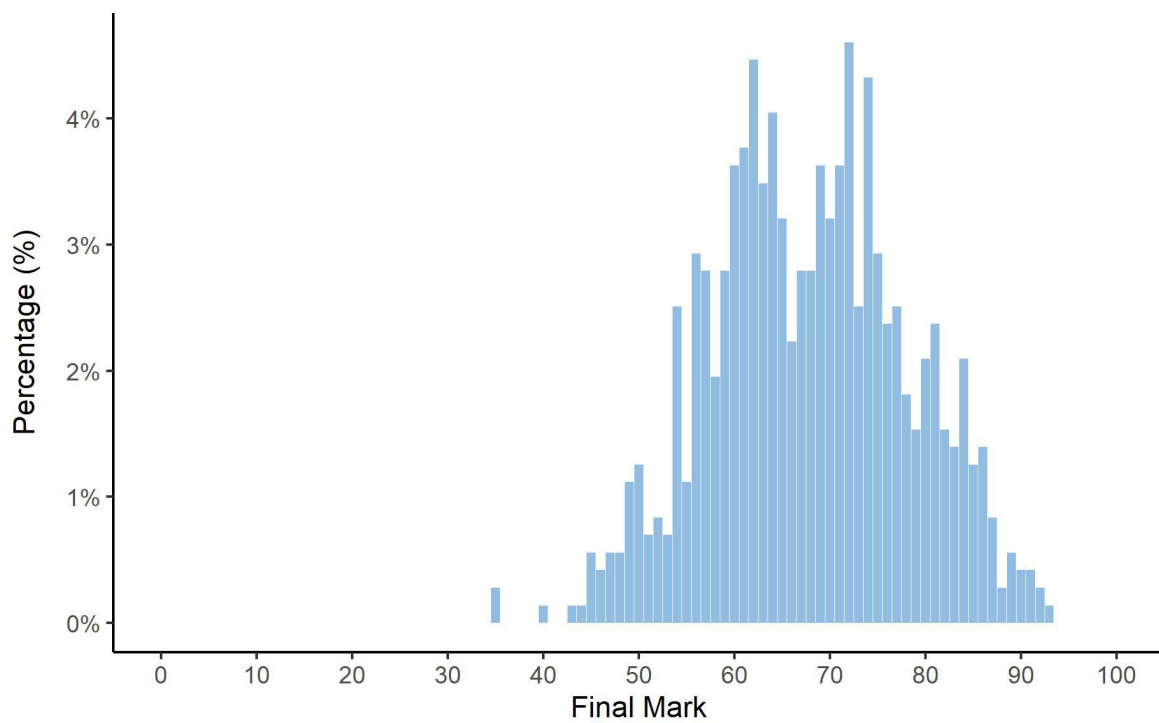


External assessment (EA) marks



Final subject results

Final marks for IA and EA



Grade boundaries

The grade boundaries are determined using a process to compare results on a numeric scale to the reporting standards.

Standard	A	B	C	D	E
Marks achieved	100–82	81–67	66–47	46–19	18–0

Distribution of standards

The number of students who achieved each standard across the state is as follows.

Standard	A	B	C	D	E
Number of students	76	309	320	12	0

Internal assessment



The following information and advice relate to the assessment design and assessment decisions for each IA in Units 3 and 4. These instruments have undergone quality assurance processes informed by the attributes of quality assessment (validity, accessibility and reliability).

Endorsement

Endorsement is the quality assurance process based on the attributes of validity and accessibility. These attributes are categorised further as priorities for assessment, and each priority can be further broken down into assessment practices.

Data presented in the Assessment design section identifies the reasons why IA instruments were not endorsed at Application 1, by the priority for assessments. An IA may have been identified more than once for a priority for assessment, e.g. it may have demonstrated a misalignment to both the subject matter and the assessment objective/s.

Refer to *QCE and QCIA policy and procedures handbook v4.0*, Section 9.5.

Percentage of instruments endorsed in Application 1

Number of instruments submitted	IA1	IA2	IA3
Total number of instruments	48	48	48
Percentage endorsed in Application 1	47%	79%	87%

Confirmation

Confirmation is the quality assurance process based on the attribute of reliability. The QCAA uses provisional criterion marks determined by teachers to identify the samples of student responses that schools are required to submit for confirmation.

Confirmation samples are representative of the school's decisions about the quality of student work in relation to the instrument-specific marking guide (ISMG), and are used to make decisions about the cohort's results.

Refer to *QCE and QCIA policy and procedures handbook v4.0*, Section 9.6.

The following table includes the percentage agreement between the provisional marks and confirmed marks by assessment instrument. The Assessment decisions section of this report for each assessment instrument identifies the agreement trends between provisional and confirmed marks by criterion.

Number of samples reviewed and percentage agreement

IA	Number of schools	Number of samples requested	Number of additional samples requested	Percentage agreement with provisional marks
1	48	279	0	100%
2	48	286	53	56.25%
3	48	274	58	43.75%



Data test (10%)

This assessment focuses on the application of a range of cognitions to multiple provided items. Student responses must be completed individually, under supervised conditions, and in a set timeframe.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions*
Alignment	19
Authentication	0
Authenticity	0
Item construction	1
Scope and scale	8

*Each priority might contain up to four assessment practices.

Total number of submissions: 48.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- included datasets that were clearly aligned to Unit 3 subject matter, i.e. The reef and beyond and Changes on the reef
- included datasets and questions that were of appropriate scope and scale, e.g. datasets clearly based on data from the mandatory or suggested practicals.

Practices to strengthen

It is recommended that assessment instruments:

- use cognitive verbs that clearly align with the objective being assessed as listed in the Mark allocations table (Syllabus section 4.5.1), e.g. objective 4 items used 'compare', 'draw conclusions'
- avoid items that assess objective 1, i.e. describe and explain scientific concepts, theories, models and systems and their limitations

- include a marking scheme that clearly and consistently matches each mark to an important feature in the expected response, e.g. one mark for working and one mark for calculating the correct value.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions*
Bias avoidance	0
Language	1
Layout	0
Transparency	4

*Each priority might contain up to four assessment practices.

Total number of submissions: 48.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- used cues that clearly referred to the relevant datasets, e.g. 'Refer to Figure 1'
- used formatting features (e.g. legends, figure labels) to make task elements clear
- featured a clearly identifiable cognition (e.g. calculate, identify, determine, compare) in the instruction.

Practices to strengthen

There were no significant issues identified for improvement.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Data test	100%	0%	0%	0%

Effective practices

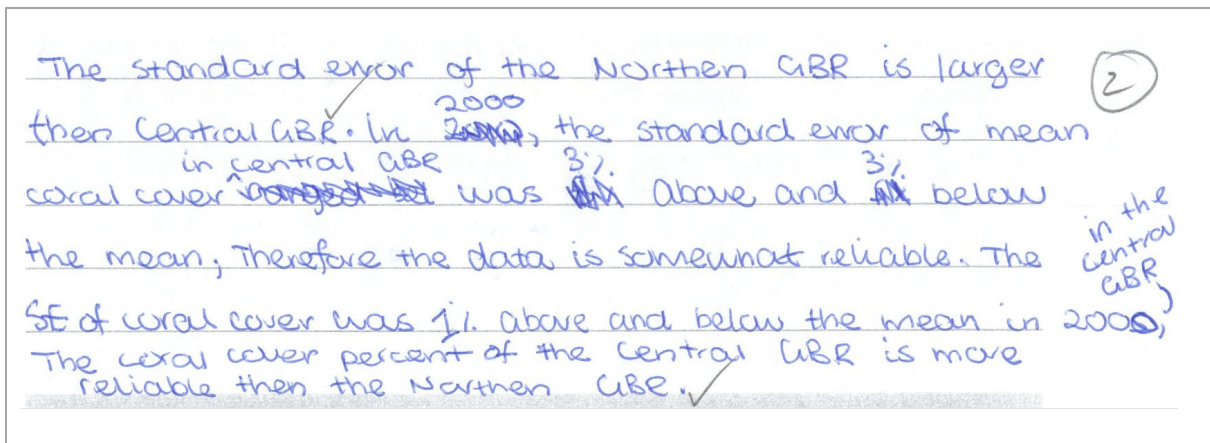
Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- marking schemes clearly matched each mark to a valued feature of the expected response
- marking schemes included an appropriate range of acceptable responses
- marking schemes were updated during the marking process to incorporate unexpected but acceptable student responses
- schools calculated mark totals and percentages and correctly used the percentage cut-offs from the ISMG to determine the final mark out of 10.

Samples of effective practices

The following excerpt demonstrates a student response to an objective 4 item that required students to interpret evidence concerning coral cover in different locations and draw a conclusion about the reliability of data.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.



The following excerpt demonstrates a student response to an objective 4 item that required students to interpret evidence concerning coral cover and species richness and draw a conclusion about the statistical relationships between two sites.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

The P-values for Lizard Island (0.001) suggests that there is statistical significance in the data and there was less room for chance, meaning the relationship between variables/results are significant. The P-value for Christmas island is greater than 0.05 which indicates no statistical significance, meaning the results are likely due to chance or error, they show that there is no statistically significant relationship ^{or results} between live coral cover and species richness on Christmas island.

Practices to strengthen

There were no significant issues identified for improvement.



Student experiment (20%)

This assessment requires students to research a question or hypothesis through collection, analysis and synthesis of primary data. A student experiment uses investigative practices to assess a range of cognitions in a particular context. Investigative practices include locating and using information beyond students' own knowledge and the data they have been given.

Research conventions must be adhered to. This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions*
Alignment	5
Authentication	1
Authenticity	0
Item construction	3
Scope and scale	0

*Each priority might contain up to four assessment practices.

Total number of submissions: 48.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- featured mandatory or suggested practicals from Unit 3 for students to use as the basis for their methodology and research question, e.g. 'Examine fish diversity using a timed swim technique'
- used authentic and locally relevant contexts and/or issues as the basis of the practicals
- used checkpoints that manage modifications to mandatory practicals to ensure compliance with the 'Safety and ethics' considerations (Syllabus section 1.2.4).

Practices to strengthen

It is recommended that assessment instruments:

- clearly indicate how individual student work will be assessed when students work in a group, e.g. through the task description or authentication strategies
- provide the full list of task specifications (Syllabus section 4.5.2).

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions*
Bias avoidance	0
Language	1
Layout	0
Transparency	4

*Each priority might contain up to four assessment practices.

Total number of submissions: 48.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- provided clear and consistent instructions that aligned to the specifications within the syllabus, assessment objectives and ISMG
- communicated task elements clearly and concisely
- featured checkpoints to monitor student progress throughout the task, e.g. specific weeks to select modifications, complete the risk assessment, collect and analyse data, submit a draft, submit the final response.

Practices to strengthen

It is recommended that assessment instruments:

- avoid repetition of syllabus requirements in different sections of the task.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Research and planning	64.58%	31.25%	4.17%	0%
2	Analysis of evidence	72.92%	20.83%	4.17%	2.08%
3	Interpretation and evaluation	72.92%	20.83%	4.17%	2.08%
4	Communication	95.83%	0%	4.17%	0%

Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- in the Analysis of evidence criterion
 - evidence of *correct and relevant* processing of data was provided in the form of correct sample calculations
 - relevant trends, patterns or relationships were *thoroughly* identified using relevant parameters calculated from the data, e.g. standard deviation, percentage cover, diversity index
 - *thorough* identification of uncertainties and limitations in data was demonstrated through application of appropriate analytical processes, e.g. standard error, t-tests
- in the Interpretation and evaluation criterion
 - *justified* conclusions clearly linked the research question to the analysis of evidence
 - improvements and extensions were *logically derived* from the uncertainty and limitations identified in the analysis of evidence.

Samples of effective practices

The following excerpt demonstrates a considered rationale leading to the development of a specific and relevant research question.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

When CO₂ enters the ocean, it forms carbonic acid, releasing hydrogen ions. These hydrogen ions then bind to carbonate ions to bicarbonate, reducing the amount of carbonate ions available to form calcium carbonate, which is what corals skeletons are made of (Yale Climate Connections, 2008).

The current global ocean pH is 8.1, although it was 8.2 prior to the industrial revolution (United States Environmental Protection Agency, 2021). There are projected pH concentrations based on the RCP that plays out. By 2100 ocean pH is projected to be between 7.75 and 8.05 (European Environment Agency, 2021). Although corals can tolerate pH levels between 7.8 and 8.4, their skeletal density decreases, making them more susceptible from physical damage, such as storms (WHOI, 2018).

Research Question: Does the wet mass of coral decline over a period of 17 days when the pH of distilled water is changed to 8.05 and 7.75, due to the effect of ocean acidification?

The following excerpt demonstrates improvements and extensions that are logically derived from the analysis of evidence and a conclusion that clearly answers the research question.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

Extensions and Improvements

To improve upon the experiment the pH should be monitored more regularly, to help maintain the desired pH. Whilst this was done every few days, daily would be better, as it is inappropriate to assume that this could accurately model ocean acidification, because the pH is constantly being buffered (Cornwall & Hurd, 2015). Although ten samples are better than three, outliers were still present in the data. More samples will provide a better representation of the data. ✓

To extend upon this experiment, the coral species used in the experiment should be identified, to gain a better understanding of the effect of ocean acidification on certain species. This would help predict which species will survive the century. It is known that reef building corals are susceptible to ocean acidification, but not much is known about non-reef building corals. Future experiments could compare the decrease in mass between the two (Lopes, 2018). As mentioned in the rationale, there are multiple RCP scenarios, an extension of this experiment could be to model each of the scenarios, rather than just the highest and lowest pH. ✓

Conclusion

To answer the research question, yes, coral mass does decline when the pH is lowered. Though all the results were not expected. It wasn't expected that the pH of 8.1 would experience a greater decline in mass, in contrast to the pH of 7.8, although there is ambiguity to if that is true. Further testing, with a refined method, is required to more accurately determine the effect of lowering the pH on coral mass. ✓ conc. linked to RQ.

Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- in the Research and planning criterion
 - a *considered* rationale clearly and directly relates the experiment to Unit 3 subject matter, i.e. The reef and beyond or Changes on the reef
 - a *specific* research question focuses on only one factor, e.g. identifying a trend between an independent variable and a dependent variable

- *justified* modifications ensure that sufficient, relevant raw data will be collected
- when considering management of risk and ethical/environmental issues, each issue is clearly stated (including for virtual experiments), e.g. how the placement of an underwater camera may impact the environment.

Additional advice

- Appendixes should only include supplementary material that will not be directly used as evidence when marking the response (*QCE and QCIA policy and procedures handbook v4.0*, Section 8.2.6). If raw data is included in an appendix, there must be evidence of collection of sufficient and relevant raw data in other areas of the response, e.g. methodology, sample calculations and data presentation.



Research investigation (20%)

This assessment requires students to evaluate a claim. They will do this by researching, analysing and interpreting secondary evidence from scientific texts to form the basis for a justified conclusion about the claim. A research investigation uses research practices to assess a range of cognitions in a particular context. Research practices include locating and using information beyond students' own knowledge and the data they have been given.

Research conventions must be adhered to. This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions*
Alignment	2
Authentication	0
Authenticity	0
Item construction	3
Scope and scale	0

*Each priority might contain up to four assessment practices.

Total number of submissions: 48.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- featured claims that will allow students to generate unique responses, e.g. 'Ocean acidification has no indirect ecological consequences'; 'Traditional ecological knowledge influences management strategies used to support marine ecosystem health'
- expressed checkpoints in a way that provided the school with flexibility within a defined timeline, e.g. 'Week 5: Submit a complete draft for feedback'
- used scaffolding that directed students to address all elements of the task.

Practices to strengthen

It is recommended that assessment instruments:

- ensure that task specifications are consistent throughout the instrument, e.g. if a written response is specified in the task conditions, ensure that later task specifications do not indicate a multimodal presentation as an acceptable response type.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions*
Bias avoidance	0
Language	2
Layout	0
Transparency	0

*Each priority might contain up to four assessment practices.

Total number of submissions: 48.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- featured claims written using clear, succinct language with accurate spelling, punctuation and grammar, e.g. 'Managing commercial fishing effort is insufficient to combat declining fish stocks'.

Practices to strengthen

There were no significant issues identified for improvement.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Research and planning	66.67%	31.25%	0%	2.08%
2	Analysis and interpretation	62.5%	33.33%	0%	4.17%
3	Conclusion and evaluation	54.17%	45.83%	0%	0%
4	Communication	93.75%	4.17%	2.08%	0%

Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- in the Research and planning criterion
 - a *considered* rationale identified clear development of the research question from the claim
 - *sufficient* and *relevant* sources were drawn from a variety of scientifically credible sources
- in the Analysis and interpretation criterion
 - the identification of trends, patterns or relationships and the identification of limitations of evidence were presented clearly
 - *thorough* and *appropriate* identification of limitations was specific to the research question and identified how or why each limitation made the evidence less effective
 - *justified* scientific arguments were supported by evidence and linked to the research question.

Samples of effective practices

The following excerpt demonstrates thorough identification of trends, and thorough and appropriate identification of limitations of the evidence.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

Evidence

Source 1

The DAF released 'Towards an Initial Quota for the Queensland Mud Crab Fishery – 2019', to investigate the feasibility of a quota-based management system. An annual catch limit is set for the year, referred to as the TAC (Hilborn and Walters, 2013) as cited in (DAF QLD, 2019). The QLD mud crab fishery has not had a TAC or quota managed system in the past, therefore reporting practices are uncertain. The research used data from 1988/89 to 2017/18 containing annual commercial harvests, and estimations of recreational harvests, derived from state-wide phone-diary surveys (DAF QLD, 2019).

Thorough trends

Anomalies were noted in the catch data for the 2003/04 harvest (figure 1), revealing that figures exceeded previous years, identified as an estimated 30% over-reporting (DAF QLD, 2019) by crabbers, as perceptions were that quota allocations would be based on catch histories. Similarly skewed data trends were observed in 2010/11 with a 1200t harvest reported, which again dropped in 2016/17 to 850t (figure 1). For the period 2010/11 to 2016/17 the 30% over-reporting factor is represented by the green line as the 7 year average, whereas the purple line represents the over-reported 7 year average.



Figure 1 Commercial harvests for mud crab for the east coast of Queensland. (DAF QLD, 2019).

Thorough + appropriate limitations

As catch data is reliant on the self-reporting logbooks, the harvest data is unreliable. These known biases in the data pose major limitations and therefore the QLD target of 60% biomass for EC1's by 2027 cannot be supported by the available data.

Samples of effective practices

The following excerpt demonstrates suggested improvements and extensions that are relevant to the claim.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

Improvements

- More time to explore recent bleaching events (eg 2020) effects on tourism economic value
- Find more data predicting future outcomes with quantitative values for economic loss
- Investigate the impact on economic value regarding fishing with mass bleaching events

Extensions

- Investigate the aesthetic value of the reef in response to Climate Change
- Investigate the impact on spiritual value of the reef due to Climate Change
- Investigate how rising sea surfaces impact the value of the GBR

Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- in the Conclusion and evaluation criterion
 - *justified* conclusions link the trends, patterns and relationships identified in the analysis to the research question
 - suggested improvements and extensions address limitations of evidence identified through analysis and link the evaluation back to the claim.

Additional advice

- Teachers should guide students through the research investigation to support the development of a research question and identification of relevant sources to allow successful completion of the task (IA3 effective processes and practices resource).

External assessment



External assessment (EA) is developed and marked by the QCAA. The external assessment for a subject is common to all schools and administered under the same conditions, at the same time, on the same day.

Examination (50%)

Assessment design

The assessment instrument was designed using the specifications, conditions and assessment objectives described in the summative external assessment section of the syllabus. The examination consisted of two papers:

- Paper 1, Section 1 consisted of multiple choice questions (20 marks)
- Paper 1, Section 2 consisted of short response questions (28 marks)
- Paper 2, Section 1 consisted of short response questions (55 marks).

The examination assessed subject matter from Units 3 and 4. Questions were derived from the context of The reef and beyond, Changes on the reef, Oceans of the future and Managing fisheries.

The assessment required students to respond to multiple choice and short response questions.

Assessment decisions

Assessment decisions are made by markers by matching student responses to the external assessment marking guide (EAMG). The external assessment papers and the EAMG are published in the year after they are administered.

Multiple choice question responses

There were 20 multiple choice questions in Paper 1.

Percentage of student responses to each option

Note:

- The correct answer is **bold** and in a blue shaded table cell.
- Some students may not have responded to every question.

Question	A	B	C	D
1	4.46	64.02	18.13	13.11
2	25.94	6.28	60.25	7.39
3	7.39	9.48	62.34	20.36
4	15.62	49.93	25.52	8.65
5	18.41	10.18	22.73	48.12

Question	A	B	C	D
6	18.41	11.02	49.51	20.78
7	12.97	59.27	11.85	15.76
8	5.02	65.97	20.78	8.09
9	13.53	38.35	21.48	26.50
10	39.19	25.66	27.89	6.97
11	30.82	27.06	8.09	33.89
12	23.99	54.11	2.65	19.11
13	21.62	5.72	42.68	29.85
14	35.01	22.73	3.21	38.91
15	40.03	16.88	23.57	19.39
16	34.73	16.74	26.92	21.48
17	64.16	3.21	15.76	16.74
18	4.74	19.11	50.77	25.10
19	12.97	18.41	8.23	59.97
20	9.07	21.48	20.22	48.95

Effective practices

Overall, students responded well to:

- questions requiring explanations of simple concepts
- opportunities to use evidence to draw and support conclusions and predictions
- opportunities to interpret graphical and tabulated data to identify trends, patterns and relationships.

Samples of effective practices

Short response

The following excerpt is from Question 28 from Paper 1. It required students to compare the resilience of two reefs using graphical data.

Effective student responses:

- identified a similarity
- identified a difference
- recognised the significance.

This excerpt has been included:

- to demonstrate an explanation of the significance of the differences between the two reefs.

Similarity: Both reef A and reef B were able to reach 100% coral recovery in under ten years of the disturbance event. Moreover, for both reefs, the functional diversity also increased over time, demonstrating recovery. Difference: Reef A was able to recover faster than reef B, having 100% coral recovery 7.5 years after the disturbance compared to reef B taking 9 years to receive 100% coral recovery. Moreover Reef A was also able to receive 85% functional diversity within 10.2 years of recovery compared to reef B taking 31 to receive 85% functional diversity. This clearly demonstrates how when there is an increase in coral recovery, the functional diversity also correspondingly increases in recovery. Significance: Due to this, it can be evident that reef A was faster at recovering to 100% coral cover and 85% functional diversity compared to reef B. This could be a result of numerous factors including there being more disturbances to reef B during recovery.

The following excerpt is from Question 7 from Paper 2. It required students to explain factors affecting the composition of calcium carbonate in sediment.

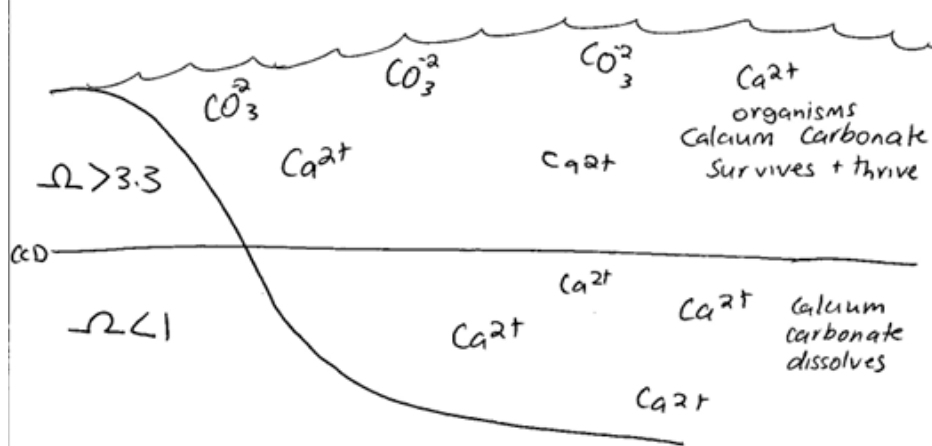
Effective student responses:

- identified the two forms of calcium carbonate
- explained that solubility is affected by depth or pressure
- identified that different forms of calcium carbonate have different solubilities
- explained the effect of the carbonate compensation depth (CCD) on sediment composition.

This excerpt has been included:

- to demonstrate the explanation of the interconnected ideas that relate to the deposition of deep-sea floor sediment.

In the deeper regions of the ocean floor, there is higher amounts of CO_2 located in the ocean. Due to this there are minimal aragonite organisms due to them being located below the CCD. (Carbonate compensation depth) Below the CCD, the aragonite $\Omega < 1$ which causes shelled organisms made from calcium carbonate to be unable to build their skeleton and will dissolve. However, when the organisms are above the CCD where $\Omega > 3.3$, the organisms are able to thrive and survive.



Practices to strengthen

It is recommended that when preparing students for external assessment, teachers consider:

- preparing students to answer multiple choice questions that require detailed or specific knowledge of syllabus concepts
- making students aware that questions that use the cognitive verb 'compare' require the identification of similarities, differences and the significance of these
- highlighting the interconnectedness of ideas when explaining concepts within a context.

Additional advice

- Teachers should model examination strategies such as effectively managing time and using the mark allocation and response space to judge the scope and scale of the response required.