NMSSA • CYCLE 2

Wānangatia te Putanga Tauira
National Monitoring Study of Student Achievement

Technical Information 2021

• Technology • Learning Languages • The Arts

NMSSA
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National Monitoring Study of Student Achievement

CYCLE 2
NMSSA Report 27

NMSSA Report 27: TECHNICAL INFORMATION 2021 – Technology; Learning Languages; and The Arts

Wānangatia te Putanga Tauira

National Monitoring Study of Student Achievement

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Educational Assessment Research Unit
and
New Zealand Council for Educational Research

NMSSA Report 27

Technical Information 2021 Technology; Learning Languages; and The Arts
(all available online at https://nmssa.otago.ac.nz/reports-and-resources/)

National Monitoring Study of Student Achievement Report 27:
Technical Information 2021 – Technology; Learning Languages; and The Arts
published by Educational Assessment Research Unit, University of Otago, and New Zealand Council for Educational Research
under contract to the Ministry of Education, New Zealand

ISSN: 2350-3238 (Online) ISBN: 978-1-927286-73-9 (Online only)

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Acknowledgements

The NMSSA project team wishes to acknowledge the very important and valuable support and contributions of many people to this project, including:

- members of the technical advisory panel
- members of the curriculum advisory panel in the learning areas of Technology; Learning Languages; and The Arts
- principals, teachers and students of the schools where the tasks were piloted and trials were conducted
- principals, teachers and Board of Trustees' members of the schools that participated in the 2021 main study including the linking study
- the students who participated in the assessments and their parents, whānau and caregivers
- the teachers who administered the assessments to the students
- the teachers and senior initial teacher education students who undertook the marking
- the Ministry of Education NMSSA Steering Group.

Introduction

This report is comprised of a set of technical appendices that supplement the suite of 2021 NMSSA Key findings reports. The appendices in this report outline the methods and procedures used to design, develop, implement, and report the results of NMSSA 2021. This report is organized into ten appendices:

- Appendix 1: Sample Characteristics for 2021
- Appendix 2: Methodology for the 2021 NMSSA Programme
- Appendix 3: NMSSA Sample Weights 2021
- Appendix 4: Variance Estimation: NMSSA 2021
- Appendix 5: Linking the Arts across Cycle 1 and Cycle 2
- Appendix 6: Linking Te Reo Māori across Cycle 1 and Cycle 2
- Appendix 7: Linking Technology across Cycle 1 and Cycle 2
- Appendix 8: Assessment Framework – The Arts
- Appendix 9: Assessment framework for Te Reo Māori in the National Monitoring Study of Student Achievement 2021
- Appendix 10: Assessment Framework for Technology

There were various technical and operational challenges to NMSSA in 2021 because of the impact of COVID-19. This included disruption to the data collection phase caused by a COVID-19 lockdown. The impact of COVID-19 on the study is described throughout the appendices.

Appendix 1:
Sample Characteristics for 2021

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Samples for 2021

A two-stage sampling design was used to select nationally representative samples of students learning in English-medium settings Year 4 and at Year 8. The first stage involved sampling schools; the second stage involved sampling students within schools.

Because the implementation was scheduled for Term 3 2021, the Ministry of Education July 2020 school returns for Year 3 and Year 7 were used to for estimating the enrolment of Year 4 and Year 8 students in 2021.

A stratified random sampling approach was taken to select 100 state and state-integrated schools at Year 3 and 100 schools at Year 7. A maximum of 25 students were randomly selected from each school to form national samples at Year 4 and Year 8.

1. Sampling of schools

Sampling is done using Ministry of Education school roll return and school directory information available via the Education Counts website. The algorithm below refers directly to the variables included in those data sets.

Sampling algorithm

From the complete list of New Zealand schools select two datasets – one for Year 3 students and one for Year 7 students.

For the Year 3 sample:

- Exclude:
    - Schools which have fewer than eight Year 3 students
    - Schools with decile 99
    - Trial schools
    - Chatham Island schools
    - Authority in:
        - Private: Fully Registered
        - Private: Provisionally Registered
    - School Type in:
        - Special School
        - Teen Parent Unit
        - Correspondence School
        - Secondary (Year 9-15)
        - Secondary (Year 11-15)
    - Definition in:
        - Kura Kaupapa Māori
        - Designated Character School
- Stratify the sampling frame by region (using the Regional Council variable) and quintile[1].
- Within each region-by-quintile stratum, order the schools by Year 3 roll size[2].
- Arrange the strata alternately in increasing and decreasing order of roll size[3].

[1] Quintile 1 comprises state/state-integrated deciles 1 and 2 schools; Quintile 2 comprises state/state-integrated deciles 3 and 4 schools; Quintile 3 comprises state/state-integrated deciles 5 and 6 schools; Quintile 4 comprises state/state-integrated deciles 7 and 8 schools; and Quintile 5 comprises state/state-integrated deciles 9 and 10 schools.

[2] Roll size refers to the year level in question e.g. roll size for Year 3 students.

[3] This is done so that when replacements are made across stratum boundaries the replacement school is of a similar size to the one it is replacing.

- Select a random starting point.
- From the random starting point, cumulate the Year 3 roll.
- Because 100 schools are required in the sample, the sampling interval is calculated as:

  $$\frac{\text{Total number of Year 3 students}}{100}$$

- Assign each school to a 'selection group' using this calculation:

  $$Selection\ group\ =\ ceiling\left(\frac{cumulative\ roll}{sampling\ interval}\right)$$

- Select the first school in each selection group to form the final sample.

Follow the same process for the Year 7 sample.

If a school is selected in both the Year 3 and Year 7 samples, assign it to one of the two samples. Locate the school in the unassigned sample and select a replacement school (next on list). Repeat the process for each school selected in both samples.

Substitution procedure

The sampling frames constituted 1,514 schools for Year 3 and 998 schools for Year 7 after exclusions had been applied.

Selected schools were invited to participate in 2021 based on 2020 July roll returns. Therefore ' 2020 Year 3 schools' became '2021 Year 4 schools' and similarly '2020 Year 7 schools' became ' 2021 Year 8 schools'. Those that declined to participate were substituted using the following procedure.

- From the school sampling frame, select the school one row below the school withdrawn.
- If this school is not available, re-select by going to one row above the school withdrawn.
- If this school is not available, select the school two rows below the school withdrawn. Continue in this sequence until a substitute is found.
- As in the initial selection process, schools were assigned to only one sample. A school already selected for one of the samples was then ineligible as a substitute in the other.

In total, 138 schools were invited for Year 4, with 38 declining (27 were from the original sample and 11 replacement schools) before a sample of 100 schools was confirmed for Year 4.

For Year 8 schools a total of 152 were invited with 52 declining (39 were from the original sample and 13 were replacement schools) before a sample of 100 schools was confirmed for Year 8.

2. Sampling of students

The sampling plan for selection of students is detailed in this section. In practice, sampling was modified partway through the study in response to the impacts of COVID-19. The implications for the achieved samples are outlined in the section 3.

Six nested student samples were intended for the study:

1. A sample that included up to 27 students, per school to complete group-administered task (GAT) assessments in t*echnology* and *Te Reo Māori,* and a contextual component for *learning languages.*
2. A subset of up to 18 students per school for the GAT in *the arts* assessments.
3. A subset of up to six students per school for in-depth (InD) assessment in *technology*.
4. A subset of up to six students per school for in-depth (InD) assessment in *visual arts*.
5. A subset of up to four students per school for in-depth (InD) assessment in *drama* and *music*.
6. A subset of up to two students per school for in-depth (InD) assessment in *dance*.

The procedure for selecting students for the samples was as follows:

- Participating schools were asked to provide a list of all students in their school at the relevant year level (Year 4 or Year 8) in 2021, identifying any students who should be excluded for logistical reasons, or because the experience would be inappropriate (e.g. high special needs (ORS), very limited English language (ESOL), Māori Immersion Level 1, would be absent during the visit, had left the school, and other health or behavioural issues).
- For each school, a computer-generated random number between 1 and 1 million was assigned to each student and they were then ranked in order of their random number from lowest to highest.
- The first 27 students in the ordered list were identified as belonging to the GAT sample for technology and learning languages.
- The first 18 students also belonged to the GAT sample in the arts.

The procedure for selecting selecting students to the in-depth (InD) assessments was as follows:

Dance = students 1 and 3

Drama = students 1, 3, 5, 7

Music = students 1, 3, 5, 7

Visual Arts = students 1, 3, 5, 7, 9, 11

Technology = students 2, 4, 6, 8, 10, 12

- The names of selected students were returned to schools for approval. Principals or contact people were given a second opportunity to identify students for whom the NMSSA assessment would be inappropriate. Any students identified for withdrawal were replaced with students listed 28 onwards from the ordered list. The resultant sample was confirmed and letters of consent were sent to the parents of selected students on our behalf via the schools.
- The children of parents who declined to have their child participate were withdrawn from the sample and were replaced in the same way as above (if there were sufficient eligible students). However, no replacements were added within two weeks of the date of the school visit, as there was insufficient time to seek parental permission.
- On-site replacements of students by teacher assessors (TAs) were made if any of the students (the InD sample) were absent or withdrawn on the first day, prior to the start of assessments. They were replaced by students ranked, on a best-match basis (e.g. using the gender/ethnicity replacement priorities).

If students were absent or withdrawn after the start of the assessment programme, no replacements were made.

3. The impact of COVID-19

The 2021 NMSSA assessment programme was interrupted by a nationwide lockdown associated with COVID-19 that occurred midway through the Term 3, 2021. This resulted in the entire programme being suspended for two and a half weeks. When the study resumed in Week 7 of the term, schools in Auckland and Northland were still in lockdown and the schools in these two regions were unable to participate. To make the most of the time remaining for data collection, the NMSSA team adjusted the programme so that one and a half, rather than two and a half days, was required in each school. This enabled a shortened assessment programme to be undertaken in most of the remaining schools outside of the Auckland and Northland in the last weeks of the term.

For this shortened programme, the sample in the nested structure was reduced from 27 to 18 students in each school.

The interruption to the programme meant that, while the intention was to sample approximately 4,400 students from the 200 schools that had agreed to take part in NMSSA in 2021, the achieved samples for 2021 were made up of about 2,200 students in total, representing 61 schools at Year 4, and 64 schools at Year 8.

The interruption to the study also affected the general representativeness of the sample across the regions, across school decile and school type, and ethnic groups. As can be seen from Tables A1.2 and A1.4 in the following section, variability was evident between the student samples and their respective population for both year levels. The impact of the COVID-19 lockdown on the sample reduces the statistical confidence associated with the 2021 results through smaller samples, particularly at the sub group level. In addition, the introduction of potential bias in the structure of the sample places some limitations on generalisability.

Achieved samples at Year 4

The following sections describe the achieved GAT and InD samples of students at Year 4 and Year 8 and contrast their demographic characteristics with those of their respective national populations (through comparison with the sample frame of all students in eligible schools). This allows us to assess the national representativeness of the samples in relation to those characteristics.

Across the 61 schools participating at Year 4, principals identified 182 students for whom the experience would be unsuitable; a further 72 students were excluded from the school sample after it had been selected and 60 further students were selected as replacements.

The initial sample consisted of 1,537 randomly selected students. Principals or parents withdrew 254 students. Substitute students numbered 230. Another 376 students were withdrawn without sufficient time for replacement, were absent or did not respond for other reasons during the assessment period. The achieved GAT sample for Te Reo Māori included 1,137 students. The achieved sample for each assessment is displayed in the bottom row of Table A1.1.

Table A1.1 The selection of Year 4 students for the GAT and InD samples from 61 schools

	GAT tasks			InD tasks (InD)				
Learning Area	**Te Reo Māori***	**Technology***	**The Arts**	**Technology**	**Visual Arts**	**Drama**	**Music**	**Dance**
Maximum students per school	*27*	*27*	*18*	*6*	*6*	*4*	*4*	*2*
Initial sample:	**1537**							
Students withdrawn by parents or principals after sampling	-254							
Substitute students used (replacements for above)	230							
Absences, non-responses and withdrawals during assessment period	-376	-303	-26	-95	-12	-57	-41	-36
Achieved sample:	**1137**	**1106**	**1015**	**265**	**169**	**63**	**83**	**26**

* Maximum number of students per school had to be reduced to 18 due to impact of COVID-19

Table A1.2 contrasts the characteristics of the samples with the sample frame across a number of key demographic variables.

Table A1.2 The composition of the Year 4 samples in comparison with the sample frame by gender, ethnicity, school quintile, school type and education region

	Sample frame *N = 60,657* **%**	**GAT samples†**			**In-depth samples†**				
		Te Reo Māori *N = 1137*	**Technology** *N = 1106*	**The Arts** *N = 1015*	**Technology** *N = 265*	**Visual Arts** *N= 169*	**Drama** *N = 63*	**Music** *N= 83*	**Dance** *N = 26*
Gender									
Boys	**51**	48	48	48	49	47	43	36	19
Girls	**49**	52	52	52	51	53	57	64	81
Ethnicity*									
European	**57**	64	65	64	63	60	59	71	73
Māori	**24**	22	21	24	23	26	22	20	23
Pacific	**13**	10	10	10	11	14	19	12	8
Asian	**18**	15	16	15	15	12	11	10	12
Other	**5**	7	7	6	7	5	8	6	8
Quintile									
1	**16**	11	10	12	12	21	17	4	8
2	**17**	14	14	15	13	11	14	14	15
3	**16**	16	16	15	16	14	13	19	15
4	**22**	25	25	23	25	22	32	29	38
5	**28**	34	35	34	35	32	24	34	23
School type									
Contributing	**61**	68	69	67	64	72	68	58	54
Full primary	**36**	32	31	33	36	28	32	42	46

	Sample frame N = 60,657 %	GAT samples†			In-depth samples†				
		Te Reo Māori N = 1137	Technology N = 1106	The Arts N = 1015	Technology N = 265	Visual Arts N= 169	Drama N = 63	Music N= 83	Dance N = 26
Region									
Auckland	**36**	17	18	16	16	14	24	24	38
Bay of Plenty/Waiariki	**8**	7	7	8	8	7	0	8	15
Canterbury	**12**	20	20	20	18	18	25	19	8
Hawkes Bay/Tairāwhiti	**5**	5	5	6	5	11	6	5	0
Nelson/Marlborough/ West Coast	**3**	4	4	4	4	4	6	5	8
Otago/Southland	**6**	9	9	9	11	4	0	10	8
Northland/Tai Tokerau	**4**	2	2	2	4	7	13	0	0
Taranaki/Whanganui/ Manawatu	**7**	7	8	7	4	4	6	5	8
Waikato	**9**	12	11	12	13	18	13	5	8
Wellington	**11**	16	16	18	17	15	6	19	8

Note: Ministry of Education July 2021 school returns for Year 4 were used for the population percentages.

* Ethnicity is based on the Ministry of Education's prioritised ethnicity statistics.

† GAT and in-depth samples were compromised due to COVID-19 related school closures.

Achieved samples at Year 8

Across the 64 schools participating at Year 8, principals identified 130 students for whom the experience would be unsuitable; a further 108 students were excluded from the school sample after it had been selected and 85 students were substituted.

The initial sample consisted of 1,586 randomly selected students. Principals or parents withdrew or excluded 238 students. Substitute students numbered 204. A further 434 students were withdrawn without sufficient time for replacement, were absent or did not respond for other reasons during the assessment period. The achieved GAT sample for Te Reo Māori included 1,118 students. The achieved sample for each assessment is displayed in the bottom row of Table A1.3.

Table A1.3 The selection of Year 8 students for the GAT and InD samples from 64 schools

	GAT tasks			InD tasks (InD)				
Learning Area	**Te Reo Māori***	**Technology***	**The Arts**	**Technology**	**Visual Arts**	**Drama**	**Music**	**Dance**
Maximum students per school	*27*	*27*	*18*	*6*	*6*	*4*	*4*	*2*
Initial sample:	**1586**							
Students withdrawn by parents or principals after sampling	-238							
Substitute students used (replacements for above)	204							
Absences, non-responses and withdrawals during assessment period	-434	-325	-39	-236	-54	-81	-37	-18
Achieved sample:	**1118**	**1105**	**1053**	**144**	**138**	**47**	**91**	**46**

* Maximum number of students per school had to be reduced to 18 due to COVID-19

Table A1.4 contrasts the characteristics of the Year 8 samples with the sample frame across a number of key demographic variables.

Table A1.4 The composition of the Year 8 samples in comparison with the sample frame by gender, ethnicity, school quintile, school type and education region

	Sample frame *N = 60,547* **%**	GAT samples†			In-depth samples†				
		Te Reo Māori *N = 1118*	**Technology** *N = 1105*	**The Arts** *N = 1053*	**Technology** *N = 144*	**Visual Arts** *N = 138*	**Drama** *N = 47*	**Music** *N = 91*	**Dance** *N = 46*
Gender									
Boys	**52**	53	53	53	51	46	47	45	33
Girls	**48**	47	47	47	49	54	53	55	67
Ethnicity*									
European	**61**	69	69	69	72	57	62	70	74
Māori	**26**	27	27	27	24	33	34	24	22
Pacific	**13**	9	9	8	10	7	2	9	9
Asian	**14**	11	11	11	11	15	21	8	9
Other	**4**	5	6	5	4	4	4	4	4
Quintile									
1	**15**	10	10	10	9	14	6	9	9
2	**16**	17	18	17	27	17	17	25	26
3	**22**	20	19	20	20	17	26	18	17
4	**24**	33	34	34	32	38	34	31	30
5	**23**	19	20	19	12	13	17	18	17
School type									
Intermediate	**47**	42	42	43	36	51	57	35	35
Full primary	**31**	41	40	41	40	40	26	44	43
Secondary (Year 7-15)	**16**	13	13	12	16	9	17	9	9
Composite (Year 1-15 & 7-10)	**5**	5	5	4	8	0	0	12	13
Region									
Auckland	**33**	15	15	14	28	22	34	9	9
Bay of Plenty/Waiariki	**8**	11	10	11	12	13	17	13	13
Canterbury	**12**	17	16	17	12	14	9	13	13
Hawkes Bay/Tairāwhiti	**5**	3	3	3	4	0	0	9	9
Nelson/Marlborough/ West Coast	**4**	1	1	1	4	0	0	3	4
Otago/Southland	**7**	9	10	9	4	9	9	4	4
Northland/Tai Tokerau	**4**	4	4	3	8	9	15	0	0
Taranaki/Whanganui/ Manawatu	**7**	11	11	12	13	9	2	13	13
Waikato	**9**	12	12	12	8	9	0	22	22
Wellington	**11**	17	17	17	7	17	15	13	13

Note: Ministry of Education July 2021 school returns for Year 8 were used for the population percentages.

* Ethnicity is based on the Ministry of Education's prioritised ethnicity.

† GAT and in-depth samples were compromised due to COVID-19 related school closures.

Appendix 2:
Methodology for the 2021 NMSSA Programme

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Introduction

This appendix outlines the methodology for the 2021 studies in Technology, Learning Languages, and The Arts undertaken by the National Monitoring Study of Student Achievement (NMSSA).

1. The Technology assessment programme

The 2021 technology assessment programme built upon the NMSSA assessment framework for technology (see Appendix 10). We used two assessment approaches to assess students' technological literacy. The first approach involved in-depth group-administered tasks (InD GATs) delivered to about 1,100 students at Year 4 and 1,100 students at Year 8. In these tasks, students focused on an artifact or object (e.g., a hole punch, or fabric with particular qualities) or a scenario presented via video clip. Items included a mixture of selected-response and short-response questions, with students recording their responses into a booklet, or directly onto a computer. The second approach consisted of one-to-one interview tasks. These tasks focused on digital technologies and included a programming component.

Table A2.1 summarises the key differences between the assessment programmes for the technology learning area in Cycle 1 and Cycle 2.

Table A2.1 The key features of the Cycle 1 and Cycle 2 technology assessment programmes

	Cycle 1 (2016)	**Cycle 2** (2021)
Coverage	The assessment reflected the NZC prior to the revision to include digital technologies. The assessment focused on the three strands of the technology learning area: technological practice, technological knowledge, and the nature of technology.	The assessment reflected the NZC following the revision to include digital technologies. The assessment focused on the three strands of the technology learning area: technological practice, technological knowledge, and the nature of technology. Two technological areas related to digital technologies were included: computational thinking for digital technologies and designing and developing digital outcomes.
Assessment approach	Group-administered tasks mainly presented on computer. 17 tasks at Year 4 and 18 tasks at Year 8.	Group-administered tasks involving video stimulus (presented on computer) or an artefact. 15 tasks at Year 4 and 17 tasks at Year 8. 8 tasks at each year level included a focus on digital technologies.
Number of students	The TELI assessment involved approximately 2,300 students at each year level.	The TELI assessment involved approximately 1,100 students at each year level.

NB *A task is an assessment context. Each task has several questions.

Development and trialling of technology tasks for the 2021 study

The NMSSA team reviewed all previously used technology tasks for possible inclusion in the 2021 assessment programme. Some items within tasks were retained in their original format to be used as link tasks, necessary for making comparisons between Cycle 1 and Cycle 2.

The team incorporated digital technologies into the assessment by modifying some existing tasks and developing new tasks New and modified tasks were piloted in local schools before being used in a NMSSA trial in March 2021 involving schools in Otago. The student responses from the pilots and the trial were used to refine the tasks and support the development of appropriate marking rubrics. An Item Response Theory (IRT) model[4] was applied to the trial data to help refine the tasks, inform the selection of tasks for the main study and explore the development of the reporting scale.

[4]IRT is an approach to constructing and scoring assessments and surveys that measure mental competencies and attitudes. IRT seeks to establish a mathematical model to describe the relationship between people (in terms of their levels of ability or the strengths of their attitude) and the probability of observing a correct answer or a particular level of response to individual questions. IRT approaches provide flexible techniques for linking assessments made up of different questions to a common reporting scale. The common scale allows the performance of students to be compared regardless of which form of the assessment they were administered.

2. The Learning Languages assessment programme

The 2021 learning languages assessment programme was based around a similar programme to the one used in 2016 (see Table A2.2). As in 2016, the 2021 programme combined questionnaires for students, teachers, and principals with a short assessment of te reo Māori (Te Reo Māori (TRM) assessment[5]). Several enhancements were made to the TRM assessment for the 2021 study. These included enlarging the bank of items that underpinned the assessment, lengthening the assessment, and administering the assessment as a computer adaptive test.

Table A2.2 The key features of the Cycle 1 and Cycle 2 Learning Languages assessment programmes

	Cycle 1 (2016)	**Cycle 2** (2021)
Programme components	In 2016, the learning languages programme involved three components. **1. Student questionnaire** The student questionnaire was computer based and focussed on: • attitudes to learning an international language* and te reo Māori • experiences of learning an international language and te reo Māori at school **2. Teacher and principal questionnaires** Teachers and principals completed a paper-based questionnaire focused on: • teacher and principal views of international language and NZSL instruction in their school* • teacher and principal views of te reo Māori year level instruction in their school • teacher confidence as an international language* and te reo Māori educator • professional learning and development in international languages*, NZSL, and te reo Māori provision for teaching international languages*, NZSL, and te reo Māori in the school **3. Achievement in te reo Māori** In 2016 NMSSA assessed knowledge and understanding of te reo Māori words and phrases. Most questions were administered using a computer-based assessment, Students answered 15 selected response questions presented on computer and three short constructed-response questions presented in a booklet. The total number of items used was 41.	In 2016, the learning languages programme involved three components. **1. Student questionnaire** The student questionnaire was computer based and focussed on: • attitudes to learning an additional language* and te reo Māori • experiences of learning an additional language* and te reo Māori at school. **2. Teacher and principal questionnaires** The teacher and principal questionnaires focused on: • teacher and principal views of additional language and NZSL instruction in their school • teacher and principal views of te reo Māori instruction in their school • teacher confidence as an additional language* and te reo Māori educator • professional learning and development in additional languages*, NZSL, and te reo Māori. **3. Achievement in te reo Māori** In 2021 NMSSA assessed knowledge and understanding of te reo Māori words and phrases. All questions were administered using a computer adaptive assessment, Students answered 15 selected response questions presented on computer and five short constructed-response questions presented in a booklet. The total number of items available was 159.
Numbers of students	In 2016 the teacher and principal questionnaires were completed by more than 230 teachers at each year level and 91 principals at each year level The te reo Māori assessment involved about 2,300 students at each year level	In 2016 the teacher questionnaires were completed by 125 teachers at Year 4 and 166 at Year 8. About 50 principals completed the principal questionnaire. The te reo Māori assessment involved about 1000 students at each year level

Development and trialling of TRM questions

The questions used in the TRM assessment came from three sources: questions developed for the 2016 study; questions from a te reo Māori assessment tool developed by NZCER; and a small selection of new questions written for use in 2021. The questions were trialled in two phases in 2020 (March and September) so that their relative difficulties could be located on the measurement scale used by the computer adaptive testing algorithm. The trial also allowed the NMSSA team to monitor the efficacy of the computer adaptive algorithm and make adjustments where necessary. The computer adaptive algorithm was designed so that students, on average, got

[5] See Appendix 9 for the 2021 assessment framework for the TRM assessment.

about half of the items they answered correct. The algorithm was also designed to ensure that students were given a minimum number of each of the three question types that made up the assessment.

3. The Arts assessment programme

The 2021 programme in the arts included two components. The first component assessed achievement in the arts using the group-administered Nature of the Arts (NoTA) assessment. This assessment included 16 tasks related to the four arts disciplines and emphasised the four strands of the curriculum: understanding the arts in context, developing practical knowledge in the arts, interpreting in the arts, and (for visual arts) developing ideas in the arts. The stimulus material for the NoTA assessment tasks was mainly presented on computer. The assessment included a mixture of selected-response and short open-ended response questions. Students were asked to write their answers to the open-ended questions in a booklet. The assessment was designed so that the information collected from students could be used to construct a scale using IRT and report student achievement as scores on the 'Nature of the Arts' scale.

The second component involved four practical tasks, one focused on each of the arts disciplines. These tasks were developed to assess one strand of the curriculum: developing practical knowledge in the arts. Each task involved students using practical skills to create an artwork. The tasks for dance and music involved the students collaborating with other students, while the task for drama involved them interacting with a teacher assessor. For visual arts, the students completed the task independently. The tasks were designed so that the information collected from students could be reported descriptively for each task.

Table A2.3 summarises the key differences between the assessment programmes for the arts learning area in Cycle 1 and Cycle 2. See Appendix 8 for the 2021 assessment framework for the arts.

Table A2.3 The key features of the Cycle 1 and Cycle 2 assessment programmes in the arts

	Cycle 1 (2015)	**Cycle 2** (2021)
Coverage	Across dance, drama, music, and visual arts: • Understanding the arts in context • Developing practical knowledge in the arts • Interpreting in the arts • Developing ideas in the arts (visual arts)	Across dance, drama, music and visual arts: • Understanding the arts in context • Developing practical knowledge in the arts • Interpreting in the arts • Developing ideas in the arts (all disciplines)
Programme components	In 2015 the programme of assessment in the arts involved three components. **1. Nature of the Arts assessment (NoTA)** Seventeen tasks which represented the four arts disciplines and emphasised the four strands of the curriculum. Results reported as student achievement scores on the NoTA scale. **2. Practical tasks: music and visual art** Two tasks which assessed the developing practical knowledge in the arts strand of the curriculum. Each task focused on one arts discipline, with visual art and music included. Findings reported descriptively for each task. **3. Performance ratings** Performance ratings required teachers to make best-fit judgements in relation to the performance of their students within an arts discipline, using descriptors. Two strands of the curriculum were included: developing ideas in the arts, and communicating in the arts. The assessment was designed so that the information collected from teachers could be used to construct scales using IRT and report student achievement as scores on four scales, one for each arts discipline.	In 2021 the programme of assessment in the arts involved two components. **1. Nature of the Arts assessment (NoTA)** Sixteen tasks which represented the four arts disciplines and emphasised the four strands of the curriculum. Ten of these tasks were retained from the 2015 assessment. Results reported as student achievement scores on the NoTA scale. **2. Practical tasks: 4 arts disciplines** Four tasks which assessed the developing practical knowledge in the arts strand of the curriculum. Each task focused on one arts discipline, and all four arts disciplines were included. Findings reported descriptively for each task.
Numbers of students	The Nature of the Arts assessment was completed by approximately 2,200 students at each of Years 4 and 8.	The Nature of the Arts assessment was completed by approximately X Year 4 students and X Year 8 students

	Cycle 1 (2015)	Cycle 2 (2021)
	Practical tasks for visual art and music were completed by approximately 600 students at each of Years 4 and 8. Performance ratings in each of the four arts disciplines were completed for 200–250 students at Year 4 and 170–250 students at Year 8.	Number of students completing the practical tasks for each discipline: • Visual art: 169 students at Year 4 and 138 students at Year 8 • Music: 83 students at Year 4 and 91 students at Year 8 • Dance: 26 students at Year 4 and 46 students at Year 8 • Drama: 63 students at Year 4 and 47 students at Year 8

NB *A task is an assessment context. Each task has several questions.

Development and trialling of tasks for the arts

The NMSSA team reviewed all tasks from 2015 for possible inclusion in the assessment programme for Cycle 2. Some tasks were retained in their original format to be used as link tasks, necessary for making comparisons between Cycle 1 and Cycle 2.

New tasks were developed and piloted in local Dunedin schools before being used in a NMSSA trial in March 2020 involving schools in Otago. The student responses from the pilots and the trial were used to refine the tasks and support the development of appropriate marking rubrics. An IRT model[6] was applied to the trial data to help refine the tasks, inform the selection of tasks for the main study and explore the development of the reporting scales.

4. Administration of the assessment tasks

The 2021 study was carried out in Term 3 of 2021. Twelve teacher assessors were trained in the administration of tasks during a five-day training programme prior to the main study. During the study, the teacher assessors were carefully monitored and received feedback to ensure consistency of administration. Student responses were captured on video and paper, and stored electronically for marking (responses on paper were scanned).

The 2021 NMSSA assessment programme was interrupted by a nationwide lockdown associated with COVID-19 that occurred midway through data collection in Term 3. This resulted in the entire programme being suspended for two and a half weeks. When the lockdown was over, NMSSA implemented a shortened programme in the schools that had not yet been visited and that were still able to be involved. This did not include schools in Auckland where the lockdown continued. The interruption to the programme meant that the national sample for 2021 was made up of fewer students from a smaller number of schools than was originally intended. In total, about 1,100 students were involved in the study at each year level. The students represented 61 schools at Year 4 and 64 schools at Year 8. This compares with the original intention to sample about 2,200 students from 100 schools at Year 4 and 100 schools at Year 8.

5. Marking

Marking occurred immediately after the administration stage had concluded. Teacher markers, one of whom had been a teacher assessor, and final-year University of Otago College of Education students were employed to mark the tasks. All markers were trained, and quality assurance procedures were used to ensure consistency of marking. This included double marking of tasks and the consideration of inter-marker agreement rates.

In preparation for marking and based on student samples from the main study, the marking schedules were refined, as necessary, to ensure they reflected the range of responses found in the field. Students' scores were entered directly by the markers into the electronic database.

6. Creating the achievement scales

The Rasch IRT model was applied to student responses from the study to construct scales associated with achievement. This approach included analysing the items used in the assessments for any differential item functioning (DIF) with

[6] IRT is an approach to constructing and scoring assessments and surveys that measure mental competencies and attitudes. IRT seeks to establish a mathematical model to describe the relationship between people (in terms of their levels of ability or the strengths of their attitude) and the probability of observing a correct answer or a particular level of response to individual questions. IRT approaches provide flexible techniques for linking assessments made up of different questions to a common reporting scale. The common scale allows the performance of students to be compared regardless of which form of the assessment they were administered.

respect to year level, gender and ethnicity. Items that showed DIF were examined by the task developers, and if their inclusion could not be defended, responses to these items were not included in the scale. In the case of DIF related to year level, the affected items were sometimes split into separate Year 4 and Year 8 items. Very few items showed DIF.

The IRT approach allowed sets of plausible values to be generated for each student involved in the study related to achievement on each of the scales. Plausible values account for the imprecision associated with scores in an assessment, which can produce biased estimates of how much achievement varies across a population. Each set of plausible values represents a random sample of the possible scores a student might reasonably be expected to attain given their responses to the assessment items. Plausible values provide more accurate estimates of population and subgroup statistics, especially when the number of items answered by each student is relatively small.

Three scales were developed in 2021 across the three learning areas. These were:

- Technological literacy in technology
- Te Reo Māori in learning languages
- The Nature of the Arts in the arts.

The scales developed for te reo Māori and technology represented a continuation of the scales developed for the respective studies in Cycle 1. The scale developed for technology, however, was not considered to be a continuation of the Cycle 1 scale. This was due to changes made to the technology assessment to accommodate digital technology. NMSSA provided an indication of how achievement in technology had changed across cycles by providing a comparison of scores on items used in both cycles. These were presented graphically using 'barbell plots' (see Figure A2.1). Further information about the process used to link the Cycle 1 and Cycle 2 scales can be found in Appendices 5, 6, and 7.

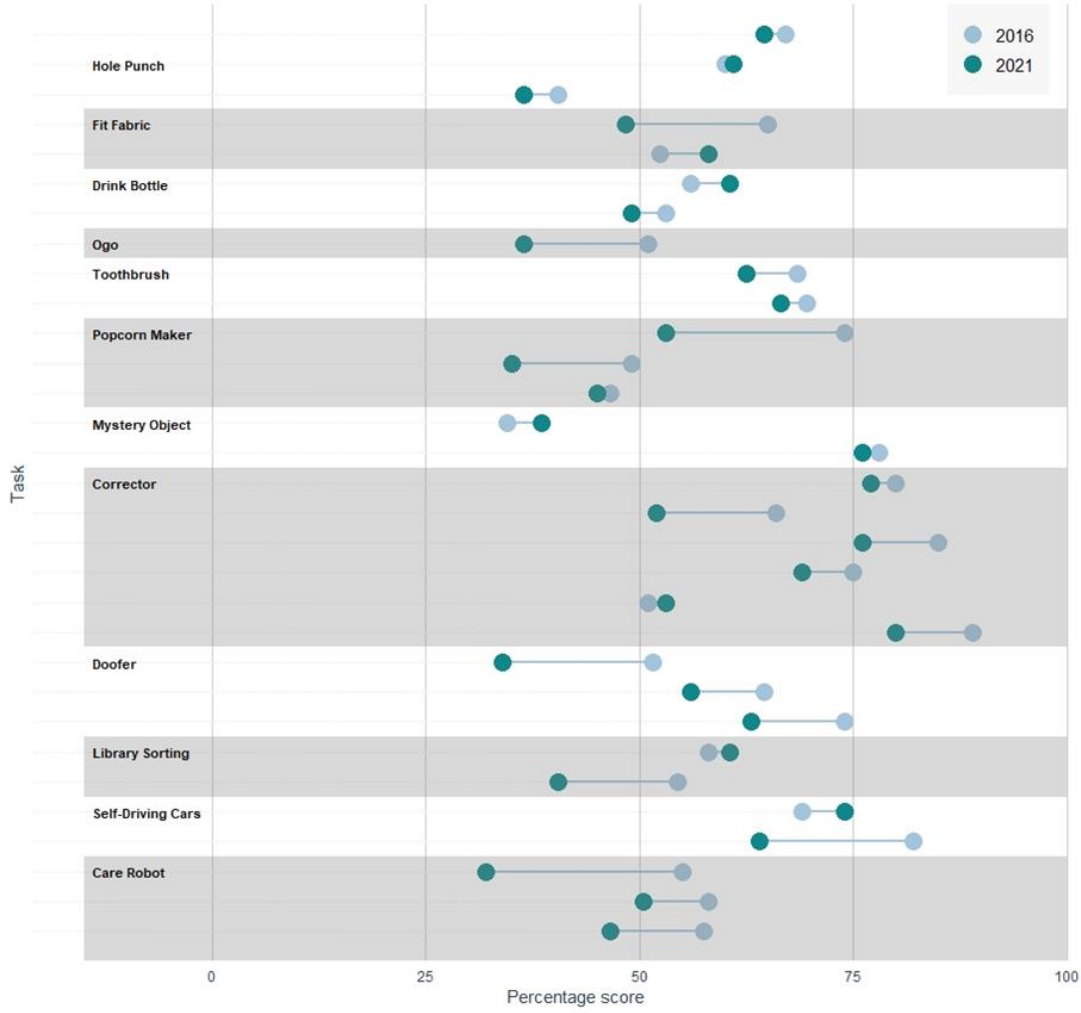

Figure A2.1 An example of the barbell plot used to show how scores on common item had changed across cycles for technology

Standardising the scales

When NMSSA scales are constructed, they are standardised so that:

- the mean of Year 4 and Year 8 students combined is equal to 100 scale score units
- the average standard deviation for the two year-levels is equal to 20 scale score units.

Scales used over more than one cycle can 'lose' these means and standard deviations as achievement patterns change over time. Achievement on the scales generally ranges from about 20 to 180 units.

Scale descriptions

Each of the three scales in the three learning areas were described to indicate the range of knowledge and skills assessed. To create the scale descriptions, the scoring categories used to score responses to each item (e.g. 0, 1, 2 or 3) were located on the respective scales. This identified where the students who scored in each category were most likely to have achieved overall on the scale. Once this had been done for all items, the NMSSA team identified the competencies exhibited as the scale locations associated with the different scoring categories increased, and students' responses became more sophisticated. The result was a multi-part description for each scale, providing a broad indication of what students typically know and can do when achieving at different places on the scale.

The descriptions were provided to give readers of the NMSSA key findings reports a strong sense of what kinds of capabilities were associated with increasing levels of success on the assessments. The scale descriptors were not written to necessarily 'line up' with curriculum levels or achievement objectives. They were a direct reflection of what was assessed and how relatively hard or easy students found the content of the assessments.

7. Reporting achievement against curriculum levels

The curriculum alignment exercises carried out in Cycle 1 for the arts (2015) and learning languages (2016) allowed the results in 2021 to also be reported against curriculum levels. In technology, substantial changes were made to the assessment used in 2016 to accommodate the revision of the NZC to include digital technologies. This meant that results from 2016 and 2021 could not be compared using the same scale and that it was not appropriate to use the same cut scores when defining expected scoring ranges associated with performance at different curriculum levels. We did not undertake a new curriculum alignment exercise for the 2021 technology assessment because of the upcoming refresh of the NZC, and the relative newness of the digital technologies content in the learning area.

8. Development of questionnaires for examining contextual information

In order to gain a better understanding of student achievement in New Zealand, NMSSA collects contextual information through questionnaires to students, teachers and principals.

Student questionnaire

The student questionnaire gathered information about the languages students speak at home. Within each of the three learning areas (technology, learning languages, and the arts), questions were focused around three themes: students' attitudes to the learning area, students' confidence in the learning area, and the learning opportunities students had experienced related to the learning area.

Four IRT scales were constructed from the student questionnaire data:

- Attitude to technology
- Confidence in technology
- Attitude to te reo Māori
- Confidence in te reo Māori.

Teacher questionnaire

The teacher questionnaire gathered demographic information about teachers. This included their gender, ethnicity, and teaching experience. Questions for teachers in each of the three learning areas focused on five themes. These were teachers' attitudes to the learning area, their confidence in the learning area, the learning opportunities they had provided for students, the professional support they received for teaching (for example, the professional

development they had received), and their responsibility within the learning area, in particular, whether they were a specialist teacher.

Principal questionnaire

The principal questionnaire included questions focused on demographic information (gender), and school characteristics (attendance rates, transience, and the proportion of students with English as a second language). Questions within each of the three learning areas focused on three themes. These included school structures that support learning (for example the use of specialist teachers to deliver programmes and the recency of PLD), teaching and learning (for example, schoolwide processes to support planning, assessment, and reporting) and resourcing.

Measurement scales for the questionnaires

The scales associated with the questionnaires were constructed using the Rasch model. Unlike the achievement measures, plausible values were not generated for the contextual scales. Each contextual scale was standardised in the same way as the achievement scales.

To aid interpretation of the contextual scales, the scales were divided into separate score ranges to provide different reporting categories. For instance, the Confidence in Technology scale was broken down into three score ranges: very confident, confident, and not confident. The 'very confident' part of the scale was associated with students mainly using the 'totally agree' category to respond to each of the questionnaire statements related to confidence, the 'confident' section of the scale was associated with students mainly using either 'agree a lot' or 'agree a little', and the 'not confident' part of the scale was associated with students mainly using 'do not agree at all'.

9. Administration of the questionnaires

The student questionnaire was administered on laptop computers supplied by NMSSA. There were three questionnaires: one for each of the three learning areas. Students responded to the appropriate questionnaire after completing group assessment tasks from the learning area.

Up to four teachers from each school were invited to complete the teacher questionnaire. This included any specialists teaching technology to the students selected for the study, and the classroom teachers in each school with the most students selected. The principal in each school was invited to complete the principal questionnaire or delegate it to a designated school leader. Teachers and principals had the option of completing the questionnaire online or in a hard-copy.

Appendix 3:
NMSSA Sample Weights 2021

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Tables:

Introduction

To determine whether sample weighting should be applied to the 2021 NMSSA data, an investigation was undertaken using data from the 2021 Arts assessment. This investigation was somewhat more extensive than in previous years, due to the impacts of COVID-19 on the achieved 2021 samples. This section summarises the effect of applying sample weights in the analysis of achievement in the Arts. Tables of estimated means and standard errors follow. The tables present these statistics calculated using three different weighting approaches

- 'Unweighted' – each measurement of achievement in the Arts has weight 1
- 'Weighted' – each measurement of achievement in the Arts has weight calculated using the methodology described in *NMSSA Approach to Sample Weighting.*[7]
- 'Regionally weighted' – each measurement of achievement in the Arts has weight calculated by comparing student Year 4 and Year 8 numbers in each Territorial Local Authority in the sample frame with the analogous numbers in the achieved sample.

Regional weighting was included in the analysis to assess whether weights were needed to ameliorate the differential effect on school participation in NMSSA, by region, because of COVID-19.

1. Summary

Most weighted estimates and regionally weighted estimates were well within one standard error of the estimated unweighted mean, and those that were not, were not far beyond one standard error of the estimated unweighted mean.

The decision was to proceed with the 2021 analyses without using sample weights.

Table A3.1 NMSSA achievement in the Arts for Year 4: Comparison of estimates using unweighted and weighted data

Year 4									
Group	Unweighted		Weighted		Regionally weighted		Difference (Unweighted - weighted)	Difference (Unweighted - regionally weighted)	N students
	Mean	S.E.	Mean	S.E.	Mean	S.E.			
All	75.6	0.8	74.1	0.8	75.1	0.9	1.5	0.6	1015
Girls	80.4	1.1	78.7	1.2	79.8	1.2	1.7	0.5	523
Boys	70.6	1.1	69.7	1.2	70.1	1.2	0.8	0.5	492
Māori	66.1	1.7	64.7	1.7	64.4	1.7	1.3	1.7	240
Pacific	67.3	2.7	65.9	2.8	65.7	2.8	1.4	1.6	93
Asian	78.7	2.0	77.1	2.0	79.3	2.1	1.6	-0.6	147
Pākehā	79.3	1.0	78.4	1.0	79.3	1.0	0.9	-0.1	643
Deciles 1 - 3	61.6	1.9	61.4	1.9	60.3	1.9	0.1	1.3	177
Deciles 4 - 7	74.3	1.3	73.6	1.3	74.3	1.3	0.7	0.1	407
Deciles 8 – 10	82.6	1.1	82.3	1.1	83.5	1.1	0.3	-0.9	431

[7] *NMSSA Approach to Sample Weighting,* at https://nmssa-production.s3.amazonaws.com/documents/Sample_Weighting_NMSSA.pdf

Table A3.2 NMSSA achievement in the Arts for Year 8: Comparison of estimates using unweighted and weighted data

Year 8									
Group	Unweighted		Weighted		Regionally weighted		Difference (Unweighted - weighted)	Difference (Unweighted - regionally weighted)	N students
	Mean	S.E.	Mean	S.E.	Mean	S.E.			
All	112.7	0.8	111.8	0.8	112.8	0.8	0.9	-0.1	1051
Girls	118.1	1.1	117.1	1.1	117.9	1.1	1.0	0.2	491
Boys	107.9	1.1	107.4	1.1	108.1	1.1	0.5	-0.2	560
Māori	104.4	1.5	103.7	1.5	104.3	1.5	0.7	0.1	287
Pacific	104.5	3.0	104.3	3.0	104.7	2.8	0.2	-0.2	79
Asian	118.7	2.4	118.5	2.4	118.5	2.4	0.2	0.2	109
Pākehā	115.8	1.0	115.1	1.0	116.0	1.0	0.7	-0.2	713
Deciles 1 - 3	103.7	1.7	103.5	1.7	103.5	1.7	0.2	0.2	243
Deciles 4 - 7	112.5	1.2	112.3	1.2	113.2	1.2	0.2	-0.7	444
Deciles 8 – 10	118.8	1.3	118.5	1.3	119.6	1.3	0.3	-0.8	364

Appendix 4:
Variance Estimation: NMSSA 2021

Contents:

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1. Summary

The general approach to variance estimation in NMSSA is outlined in the technical document of the same name.[8] This summary presents the results of analyses specific to 2021.

Design effects were calculated using the data collected for the NMSSA 2021 Arts assessment. The NMSSA Arts assessment was completed by the majority of the NMSSA sample, and therefore provides high quality information regarding the clustering of students in schools, and consequently the effect on variance estimation for the whole sample.

Design effects for the whole sample and key sub-groups were investigated. In general, through experience with calculating design effects each year, it has been noted that reducing the sample size by a factor of 0.7 for calculation of population statistics, accounts for most of the design effect related to the clustered nature of the NMSSA sample.

Design effects in 2021 mostly varied between approximately 1.19 and 1.59. While the design effects in some cases are reasonably large, the effect on the width of confidence intervals is small in practice. The increase in width of the 95 percent confidence intervals is less than 1.6 NMSSA scale score points.

It was recommended that, for ease of calculation and to absorb most of the variance bias caused by the NMSSA complex sample design, the standard multiplier of 0.7 should be used to form an effective sample size in the calculation of statistics dependent on sample size.

Tables showing the effect of the NMSSA complex sample design on the 2021 Arts assessment follow.

[8] *Variance Estimation in NMSSA,* at https://nmssa-production.s3.amazonaws.com/documents/Variance_Estimation_NMSSA.pdf

2. Tables of design effects

Table A4.1 The Arts Year 4: Comparison of results for different variance estimation methods[9]

Group	Mean (logits)	Standard error in mean (logits)		Design effect	N	Effective N	Effective N as a proportion of N
		Simple random sample	Taylor series linearisation				
All	0.30	0.02	0.03	1.58	1015	641.90	0.63
Girls	0.51	0.04	0.04	1.59	446	281.70	0.63
Boys	0.15	0.04	0.04	1.50	412	276.12	0.67
Māori	-0.04	0.05	0.06	1.25	240	195.08	0.80
Pacific	0.04	0.09	0.10	1.20	75	66.28	0.83
Asian	0.41	0.06	0.07	1.35	141	106.10	0.74
Pākehā	0.46	0.03	0.04	1.38	524	381.64	0.72
Deciles 1 - 3	-0.20	0.05	0.06	1.31	177	138.88	0.76
Deciles 4 - 7	0.12	0.05	0.06	1.42	254	180.68	0.71
Deciles 8 – 10	0.52	0.03	0.03	1.19	584	491.74	0.84

[9] It should be noted that numbers of students reported in the tables in this section are not always equal to the numbers of students in these groups in the rest of this report. This is a consequence of the way the variance estimation process treats multiple membership of students in different population subgroups. As such, these numbers should be regarded as only relevant to variance estimation.

Table A4.2 The Arts Year 8: Comparison of results for different variance estimation methods

Group	Mean (logits)	Standard error in mean (logits)		Design effect	N	Effective N	Effective N as a proportion of N
		Simple random sample	Taylor series linearisation				
All	1.60	0.02	0.03	1.74	1051	604.52	0.57
Girls	1.81	0.04	0.04	1.55	425	276.04	0.65
Boys	1.46	0.04	0.05	1.90	453	240.28	0.53
Māori	1.31	0.04	0.05	1.34	287	216.06	0.75
Pacific	1.30	0.10	0.11	1.21	60	51.38	0.82
Asian	1.81	0.07	0.08	1.18	107	91.92	0.85
Pākehā	1.73	0.03	0.04	1.67	620	373.84	0.60
Deciles 1 - 3	1.28	0.05	0.06	1.43	243	172.30	0.70
Deciles 4 - 7	1.52	0.05	0.06	1.49	253	172.54	0.67
Deciles 8 – 10	1.77	0.03	0.04	1.51	555	371.18	0.66

Appendix 5:
Linking the Arts across Cycle 1 and Cycle 2

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Figures:

Introduction

This appendix describes the process used to link results from the 2015 NMSSA Arts assessment programme with results from the 2021 NMSSA Arts assessment programme, for the purposes of comparing student achievement in the Arts from these two administrations.

In 2015 and in 2021, the Arts scale was constructed using items from a paper-administered static assessment. In 2021, the NMSSA Arts assessment was made up of a combination of existing items from 2015 and items newly developed for 2021.

1. Linking approach

The 2015 and 2021 NMSSA Arts scales

In 2015, the NMSSA Arts scale was based on 48 items, with 44 of these items offered to students from both year levels.

In 2021, the NMSSA Arts scale was based on 62 items, with 57 of these items offered to students from both year levels.

A total of 31 of the Arts scale items offered in 2015 were also offered in 2021. One of the items offered in both 2015 and 2021 was only offered to Year 4 students and one item was only offered to Year 8 students but the remainder were offered to students from both year levels. These items allowed the 2015 and 2021 scales to be aligned.

Aligning the 2015 and 2021 scales

Because a new scale was created for 2021, the 2015 and 2021 scales needed to be linked to facilitate comparison across the cycles.

An initial calibration of the 2021 items was shifted to result in the final 2021 scale. The shift was such that the average 2021 initial threshold value of an appropriate subset of the items offered in both 2015 and 2021 was made equal to the average 2015 threshold value of the same items.

Of the 31 Arts items offered in both 2015 and 2021, a total of 26 linking items (items common to both assessments), were considered appropriate to use in this shift. These linking items were all offered to students from both Year 4 and Year 8, and were considered appropriate for linking between cycles because their scale locations (relative to the average scale location of all items offered in both 2015 and 2021) did not change much from 2015 to 2021.

Linking Error

The correlation between the original 2015 and the 2021 NMSSA Arts item estimates is 0.95. Figure A5.1 shows these two sets of estimates plotted against each other. While the correlation is high, there is some variance that should be incorporated in precision calculations as linking error, when making comparisons between the 2015 and 2021 administrations.

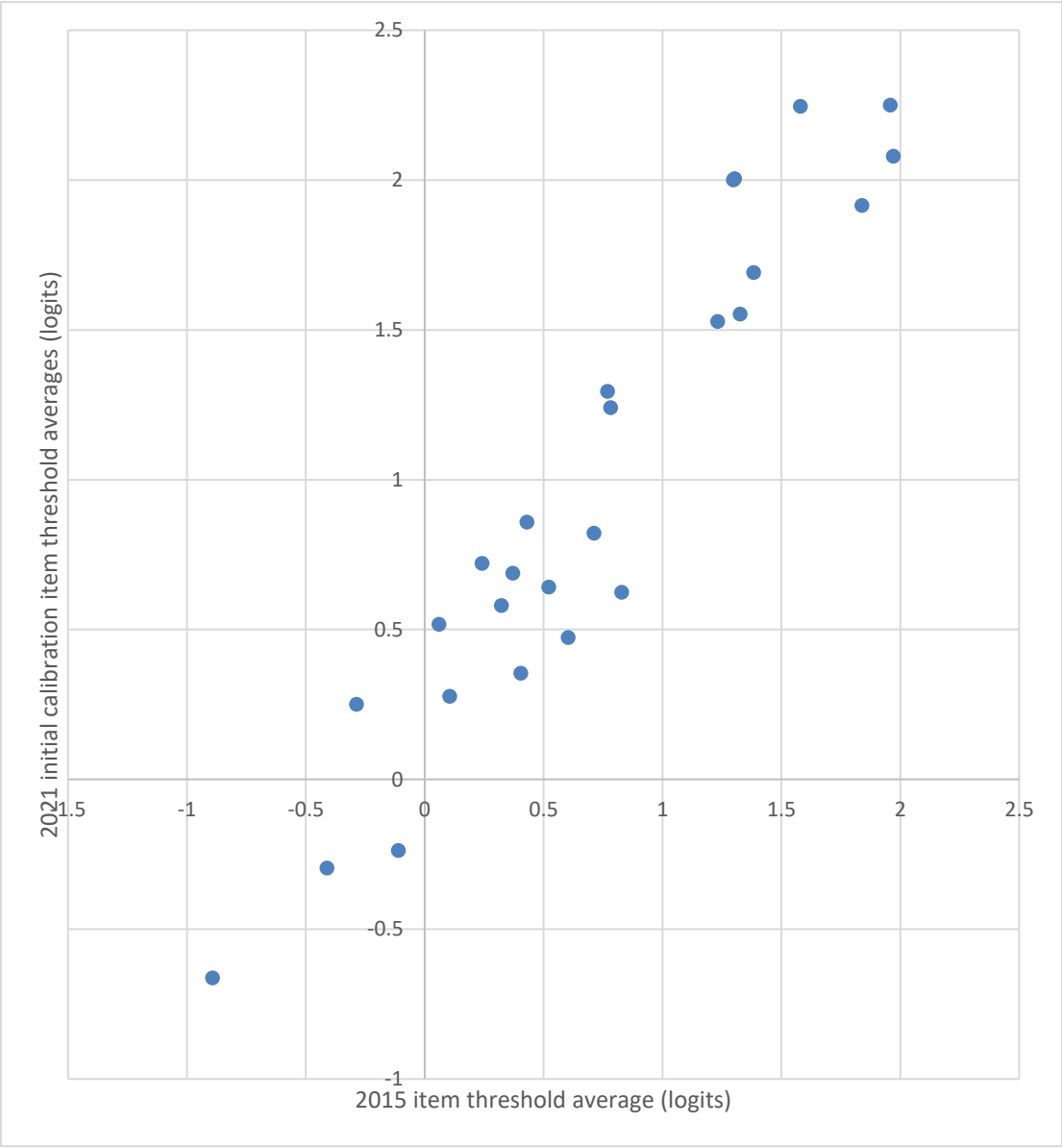

Figure A5.1 Item estimates for linking items from 2015 and 2021 calibrations

To estimate linking error, pairwise differences between the item estimates from the 2015 and 2021 calibrations, for those items common to both cycles, were used with the following formula applied:

$\sqrt{\sum_{i=1}^{L}(\delta_i - \delta_i')^2 * \frac{1}{L(L-1)}}$, where L is the number of link items, δ_i represents the average of the thresholds for item i in 2015 and δ_i' represents the average of the thresholds for item i in 2021.

Linking error was incorporated in calculation of the confidence intervals around differences in means between the cycles (for the purposes of trend analysis). The formula used for calculating the confidence interval around an observed difference was:

$1.96 * \sqrt{se_{pooled}^2 + linking\ error^2}$.

Linking error was estimated at 0.0496 (4dp).

Appendix 6:
Linking Te Reo Māori across Cycle 1 and Cycle 2

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Introduction

This appendix describes the process used to link results from the 2016 NMSSA Te Reo Māori assessment programme with results from the 2021 NMSSA Te Reo Māori assessment programme, for the purposes of comparing student achievement across Cycle 1 and Cycle 2.

In 2016, the Te Reo Māori scale was constructed using items from a computer-administered static assessment. In 2021, NMSSA assessed te reo Māori using a computer adaptive assessment, made up of a combination of existing items from 2016, multiple choice items borrowed from the NZCER Te Reo Māori vocabulary assessment tool, and open-response items newly developed for 2021.

1. Linking approach

Anchoring the 2021 NMSSA Te Reo Māori scale

The NZCER Te Reo Māori vocabulary assessment tool holds a large volume of assessment records, and includes generally good exposure of the range of items in the tool bank. The number of exposures for each item in the NMSSA Te Reo Māori (TRM) assessment, across both cycles, was much smaller. In addition, the delivery of the NMSSA TRM assessment using a computer adaptive algorithm meant that some of the items included in Cycle 2 had low exposure. In order to maximise the precision of NMSSA item calibration, the items borrowed from the NZCER vocabulary assessment tool were used to anchor the 2021 NMSSA TRM scale.

This involved undertaking a fresh calibration of the NZCER vocabulary assessment using the assessment records held within the tool. This calibration showed high reliability indices and very good item fit statistics. Resulting estimates for those items common to the 2021 NMSSA TRM assessment were fixed in a subsequent (concurrent) calibration of the combined 2016 and 2021 NMSSA TRM assessment data sets, in order to produce a full set of NMSSA item estimates. Both calibration processes (for the NZCER vocabulary assessment, and the NMSSA TRM assessment) were carried out using the TAM package in R, utilising Marginal Maximum Likelihood estimation to obtain item parameters.

While item estimates for the 2021 TRM scale were obtained through (partially anchored) concurrent calibration of 2016 and 2021 data, person scores were obtained through separate fully anchored calibrations of 2016 and 2021 data. This was to avoid the model being constrained by attempting to fit a single person distribution across the 2 cycles. TRM person score distributions were created using Plausible Values in both 2016 and 2021.

Aligning the 2016 and 2021 scales

Because a new scale was created for 2021, the 2016 and 2021 scales needed to be linked to facilitate comparison across the cycles. This linking was achieved using the assessment records from the 2016 sample.

The original calibration of 2016 TRM assessment data involved transforming student scores so that the mean of the means of each set of plausible values was 100, and the mean of the pooled standard deviations (across Year 4 and Year 8) was 20. To align the scales, the 2016 person scores derived from calibration with 2021 anchors were transformed so as to recover the same centre and spread as the original 2016 distributions, and that transformation was then applied to the 2021 person scores in order that direct comparison could be made with Cycle 1. The alignment of the scales meant there was no need to relocate cut scores.

Figure A6.1 shows the transformed 2016 plausible value distributions from the original calibration, and from the 2021 calibration.

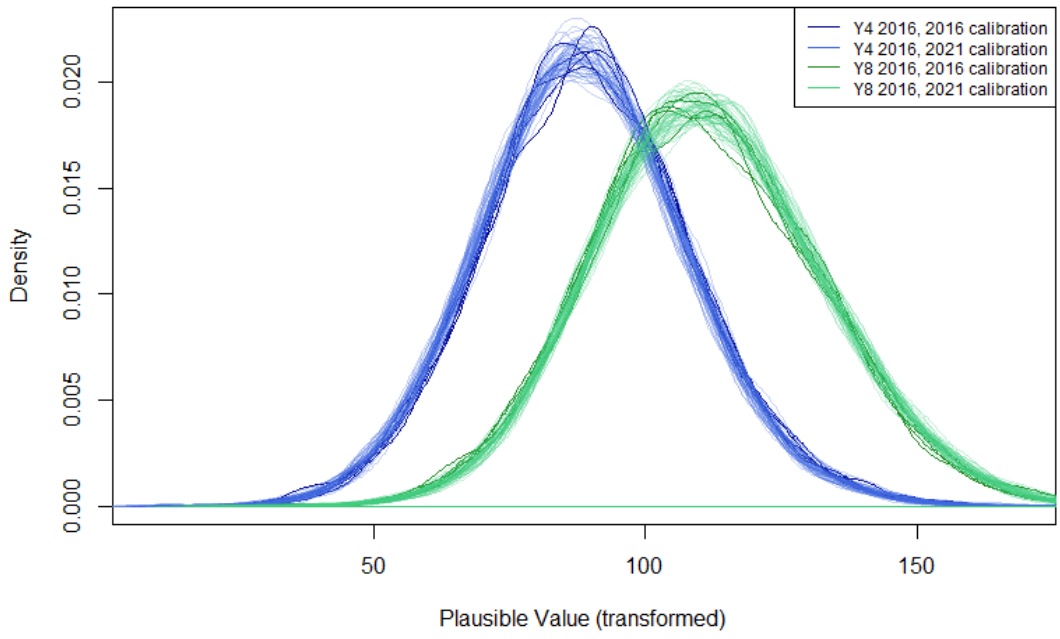

Figure A6.1 Transformed Plausible Values from 2016 and 2021 calibrations of 2016 TRM assessment data

Linking error

The correlation between the original 2016 and the 2021 (concurrent) NMSSA TRM item estimates is 0.99. Figure A6.2 shows these two sets of estimates plotted against each other. While the correlation is high, there is some variance that should be incorporated in precision calculations as linking error, when making comparisons between Cycle 1 and Cycle 2.

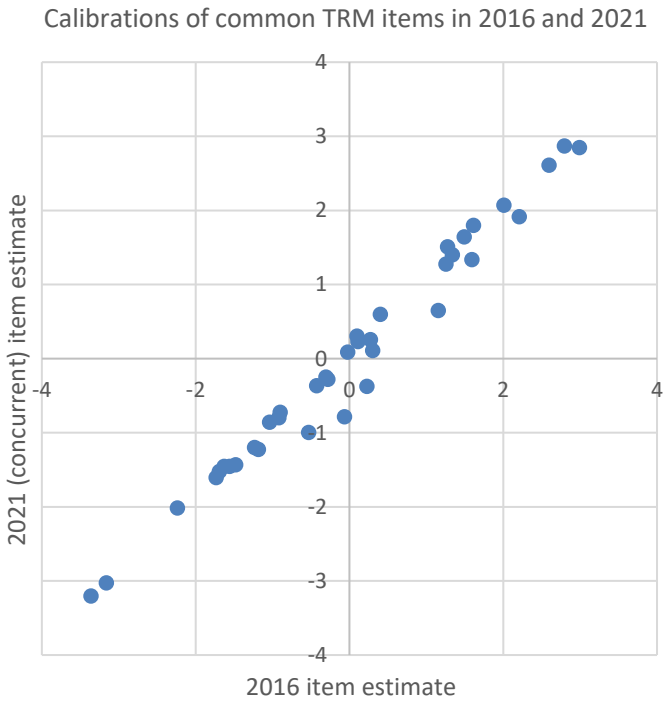

Figure A6.2 Item estimates for common items from 2016 and 2021 calibrations

To estimate linking error, pairwise differences between the item estimates from the 2016 and 2021 calibrations, for those items common to both cycles, were used with the following formula applied:

$\sqrt{\sum_{i=1}^{L}(\delta_i - \delta_i')^2 * \frac{1}{L(L-1)}}$, where L is the number of link items.

Linking error was incorporated in calculation of the confidence intervals around differences in means between the cycles (for the purposes of trend analysis). The formula used for calculating the confidence interval around an observed difference was:

$$1.96 * \sqrt{se_{pooled}^2 + linking\ error^2}.$$

Linking error was estimated at 0.0393 (4dp).

Appendix 7:
Linking Technology across Cycle 1 and Cycle 2

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Introduction

In order to make comparisons across cycles, the National Monitoring Study of Student Achievement (NMSSA) carries out analyses in each learning area to link the assessment results. This document summarises the steps conducted to link the Technological Literacy (TELI) assessments in 2016 and 2021.

In both 2016 and 2021, the TELI scale was constructed using group-administered tasks and in-depth (interview and group/team) items. The 2021 programme built upon the programme used in 2016, with particular attention given to the addition of the new digital technologies curriculum content. This new material was both integrated into existing tasks, and incorporated within new tasks. Both scales were psychometrically sound and robust measures.

1. Linking attempts

We applied two approaches (see Figure A7.1) to link the 2016 and 2021 TELI scales:

- Design A: linking the (Year 4/8) 2016 scale to the (Year 4/8) 2021 scale
- Design B: separately linking the Year 4 and Year 8 data from 2016 to the 2021 scale.

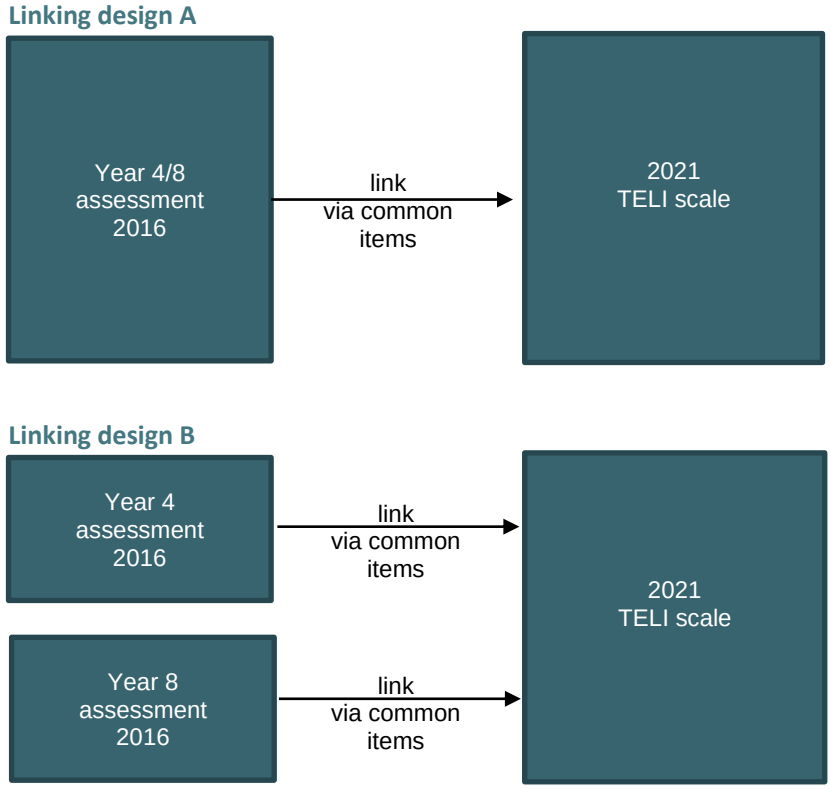

Figure A7.1 Linking schemes for NMSSA Technological Literacy

2. Linking outcomes and challenges

Even though both linking methods yielded very similar results, the trend outcomes resulting from linking were not meaningfully interpretable. The NMSSA team identified the following as possible reasons:

1. Change in the construct: Technology was introduced as a learning area in the NZC in 1995, and updated alongside all other learning areas in the 2007 revision of the curriculum. In 2017 the learning area of technology was further revised to strengthen the positioning of digital technologies within the NZC. This change was substantial.

   NMSSA assessed achievement in technology using a revision of the TELI assessment that was administered in the 2016 study. The revised assessment included material focused on the new digital technology areas. This material was both integrated into existing tasks, and incorporated within new tasks. New digital technologies curriculum content was incorporated to 2021 assessment by adding 53 new items to the 2016 assessment. This corresponds to a 100% increase given the number of items used in the

2016 assessment. It is quite possible that this significant increase in the number of questions has changed the construct being measured in 2021.

2. The 2021 NMSSA assessment programme was significantly disrupted by the COVID-19 pandemic: The disruption to the programme has meant that the national sample for 2021 is made up of fewer students from a smaller number of schools than was originally intended. In total, about 1200 students were involved in the study at each year level. The students represented 61 schools at Year 4 and 64 schools at Year 8. This compares with the original intention to sample about 2,200 students from 100 schools at Year 4 and 100 schools at Year 8.

3. Trend analysis: differences between observed means

Even if linking cannot be established between the 2016 and 2021 TELI assessments, comparisons can still be made to some extent by examining observed means on the common items used in both assessments. To achieve this, we calculated mean raw scores for each common item (at each year level) and then compared the means of these raw scores in order to inform the trend analysis commentary in the key findings.

Appendix 8:
Assessment Framework – The Arts

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Introduction

This document outlines the framework used to assess student achievement in the arts. The framework is presented by describing the following elements:

- the nature of the arts in the New Zealand Curriculum (NZC)
- the rationale and theoretical constructs underpinning the 2021 NMSSA assessment of the arts
- the two components of the assessment programme, including curriculum coverage matrices
- example assessment tasks.

1. The Arts in the New Zealand Curriculum

The NZC describes the arts as follows.

> The arts are powerful forms of expression that recognise, value, and contribute to the unique bicultural and multicultural character of Aotearoa New Zealand, enriching the lives of all New Zealanders. The arts have their own distinct languages that use both verbal and non-verbal conventions, mediated by selected processes and technologies. Through movement, sound, and image, the arts transform people's creative ideas into expressive works that communicate layered meanings. (p.20)

The overarching rationale for the arts in the NZC is

> Arts education explores, challenges, affirms, and celebrates unique artistic expressions of self, community, and culture.

More specifically the NZ describes how art education enables students to:

- connect thinking, imagination, senses, and feelings
- express ideas within creative, aesthetic, and technological frameworks
- develop confidence to take risks
- explore multiple solutions
- work both independently and collaboratively to construct meanings, produce works, and respond to and value others' contributions
- view the world from new perspectives
- participate in, interpret, value and enjoy the arts throughout their lives.

The arts learning area is represented by four strands that are common to four distinct disciplines: dance, drama, music – sound arts (hereafter referred to as music) and visual arts. The four common strands are:

- understanding the arts in context
- developing practical knowledge in the arts
- developing ideas in the arts
- communicating and interpreting in the arts.

The definitions for each arts discipline and the concept of arts literacy as described in the NZC are summarised and shown in Table A8.1.

Table A8.1 Extracts of definitions from the New Zealand Curriculum, by discipline

Discipline	Definition
Dance	Dance is expressive movement that has intent, purpose and form...[Students] integrate thinking, moving and feeling. They explore and use dance elements, vocabularies, processes, and technologies to express personal, group, and cultural identities, to convey and interpret artistic ideas, and to strengthen social interaction. [performing, choreographing, responding].
Drama	Drama expresses human experience through a focus on role, action and tension, played out in time and space.... [Students] learn to structure these elements and to use dramatic conventions, techniques, and technologies to create imagined worlds. [purposeful play, linking imagination, thoughts and feelings, use spoken and written language with increasing confidence and communicate using body language, movement and space, create, perform, analyse, reflect].
Music	Sound from natural, acoustic, and digital environments is the source material for expressive ideas in music. These ideas are manipulated and extended into forms, genres, and styles that are recognised as music.... Students develop literacies in music as they listen and respond, sing, play musical instruments, create and improvise, read symbols and notations, record sound and music works, and analyse and appreciate music [making, sharing and responding to music, drawing on cultural practices and on histories, theories, structures, technologies and personal experiences].
Visual arts	In visual arts, students develop visual literacy and aesthetic awareness as they manipulate and transform visual, tactile and spatial ideas to solve problems. They experiment with materials, using processes and conventions to develop their visual inquiries and create both static and time-based art works. The visual arts develop students' conceptual thinking within a range of practices across drawing, sculpture, design, painting, printmaking, photography and moving image. [discern, participate in, celebrate, explore experiences, stories, abstract concepts, social issues and needs].
Arts literacy	Students work collaboratively and individually; express thoughts, feelings, ideas; further creative potential; enrich the cultural lives of selves, school, whānau and community; respond, analyse, reflect, appreciate, develop aesthetic awareness, meaning making further informed by investigating contexts, particularly Māori and Pacific art forms.

The achievement objectives for each discipline reflect distinct bodies of knowledge and practice and are shown in Table A8.2.

Table A8.2 Achievement objectives for each strand of the arts in the New Zealand Curriculum, by discipline and curriculum levels 2 and 4

	Achievement objectives for each strand of the arts in the New Zealand Curriculum			
Discipline and curriculum level	**Understanding the arts in context**	**Developing practical knowledge**	**Developing ideas**	**Communicating and Interpreting**
DANCE				
Level 2	Identify and describe dance in their lives and in their communities.	Explore and identify, through movement, the dance elements of body, space, time, energy and relationships.	Use the elements of dance in purposeful ways to respond to a variety of stimuli.	Share dance movement through informal presentation and identify the use of the elements of dance.
Level 4	Explore and describe how dance is used for different purposes in a variety of cultures and contexts.	Apply the dance elements to extend personal movement skills and vocabularies and to explore the vocabularies of others.	Combine and contrast the dance elements to express images, ideas and feelings in dance, using a variety of choreographic processes.	Prepare and present dance, with an awareness of the performance context. Describe and record how the purpose of selected dances is expressed through the movement.
DRAMA				
Level 2	Identify and describe how drama serves a variety of purposes in their lives and in their communities.	Explore and use elements of drama for different purposes.	Develop and sustain ideas in drama, based on personal experience and imagination.	Share drama through informal presentation and respond to elements of drama in their own and others' work.
Level 4	Investigate the functions, purposes, and technologies of drama in cultural and historical contexts.	Select and use techniques and relevant technologies to develop drama practice. Use conventions to structure drama.	Initiate and refine ideas with others to plan and develop drama.	Present and respond to drama, identifying ways in which elements, techniques, conventions and technologies create meaning in their own and others' work.
MUSIC				
Level 2	Explore and share ideas about music from a range of sound environments and recognise that music serves a variety of purposes and functions in their lives and in their communities.	Explore and identify how sound is made and changed, as they listen and respond to the elements of music and structural devices.	Improvise, explore and express musical ideas, drawing on personal experience, listening and imagination. Explore ways to represent sound and musical ideas.	Share music making with others, using basic performance skills and techniques. Respond to live and recorded music.
Level 4	Identify and describe the characteristics of music associated with a range of sound environments, in relation to historical, social and cultural contexts. Explore ideas about how music serves a variety of purposes and functions in their lives and in their communities.	Apply knowledge of the elements of music, structural devices, and technologies through integrating aural, practical and theoretical skills.	Express, develop and refine musical ideas, using the elements of music, instruments and technologies in response to sources of motivation. Represent sound and musical ideas in a variety of ways.	Prepare, rehearse and present performance of music, using performance skills and techniques. Reflect on the expressive qualities of their own and others' music, both live and recorded.
VISUAL ARTS				
Level 2	Share ideas about how and why their own and others' works are made and their purpose, value and context.	Explore variety of materials and tools, and discover elements and selected principles.	Investigate and develop visual ideas in response to a variety of motivations, observation and imagination.	Share the ideas, feelings and stories communicated by their own and others' objects and images.
Level 4	Investigate the purpose of objects and images from past and present cultures and identify the contexts in which they were or are made, viewed and valued.	Explore and use art-making conventions, applying knowledge of elements and selected principles through the use of materials and processes.	Develop and revisit visual ideas, in response to a variety of motivations, observation and imagination, supported by the study of artists' works.	Explore and describe ways in which meanings can be communicated and interpreted in their own and others' work.

2. Rationale and theoretical constructs

The structure of the arts learning area is a challenge for the NMSSA assessment design team. Despite being described as one curriculum area, the arts comprise four arts disciplines. Even though each discipline is organised around four common strands, each discipline has its own distinctive body of knowledge, concepts and modes of enquiry and its own forms or genres, styles, conventions, and processes. Therefore, for students to make progress in the arts learning area, they have learning experiences with each arts discipline. Given this, the NMSSA arts assessment incorporates the four strands of the arts learning area of the NZC, and the four arts disciplines.

The 2021 NMSSA study of the arts follows on from the study of the arts carried out in 2015. The 2015 study involved three assessment components: a general assessment made up of tasks from across the disciplines (the Nature of the Arts (NoTA) assessment), teacher judgments of students' performance skills in each discipline; and some practical tasks in music and visual arts. In 2021, teachers' judgments were not included in order to streamline the demand on school and teacher time, and the practical tasks were extended across all four arts disciplines.

3. Components of the 2021 NMSSA assessment programme

The 2021 arts assessment programme included two components.

Component one: The Nature of the Arts (NoTA) assessment

Knowledge of and appreciation for the arts processes and fundamental concepts in the arts were assessed with a group-administered assessment called The Nature of the Arts (NoTA) assessment. The assessment included tasks associated with all four arts disciplines and primarily emphasised aspects of three strands of the curriculum: understanding the arts in context; developing practical knowledge in the arts; and interpreting in the arts. The fourth strand (developing ideas in the arts) was assessed for visual arts in NoTA. The NoTA assessment presented many of the tasks on computer and included a mixture of selected-response and short open-ended response questions. Students wrote their answers to the short-response questions in a booklet.

The NoTA assessment drew from a bank of 16 tasks. Each task included a set of items based on one theme or idea. Some items covered more than one strand of the arts curriculum. There was a balanced coverage of each discipline within the bank of tasks (four tasks from each discipline). However, the relative emphasis of each strand varied between disciplines. For example, the strand 'understanding the arts in context' was more strongly emphasised in dance and visual arts than in drama and music. During the assessment, each student answered a subset of the tasks.

Component two: Practical Tasks

The 2021 arts assessment programme included four practical tasks (see Table 2.2). Each task was associated with one of the arts disciplines and involved students using practical skills to create an artwork. The tasks for dance and music involved the students collaborating with other students, while the task for drama involved them interacting with a teacher assessor. For visual arts, the students completed the task independently. The tasks were designed so that the information collected from students could be reported descriptively for each task.

Table A10.2 presents the curriculum coverage matrix for both components of the assessment programme. A shaded cell indicates that the task was included in component one, the NoTA assessment, and the word "Task" indicates that the task was included in component two as a practical task. Note, that some tasks were included in both components of the assessment programme.

Table A8.3 Coverage matrix for the arts assessment programme

Discipline	Task Title	Understanding the arts in context	Developing practical knowledge in the arts	Interpreting in the arts	Communicating in the arts	Developing ideas in the arts
Dance	Flash Mob					
	Sāsā					
	Creating a Movement Sequence		Task		Task	Task
	Comparing Dance					
	New Zealand's Got Talent					
Drama	Working in Broken Dream		Task		Task	Task
	Broken Dream					
	Māui and the Sun					
	Working in Role (Y4&8)					
	Trouble at School (2020)					
Music	Same but Different					
	Describing a Piece of Music					
	Instruments					
	Play it Again					
	Paper Music		Task		Task	Task
Visual art	Digital Artwork (Year 8)					
	Art on Our Buildings					
	Tapa					
	White Lego					
	Draw, Draw, Draw		Task			Task

A total of 16 tasks were designed to represent the four disciplines. Each task included a set of items based on one theme or idea. An item may have covered more than one strand of the NZC. There were one or more items per task. Tasks were marked against criteria on a scale of 0-1, 0-2 or 0-3. The curriculum coverage matrix for the NoTA assessment is shown in Table A8.3.

Table A8.4 Curriculum coverage matrix for the NoTA assessment by discipline, task, number of items, score points and strand

	Number		Strand			
Discipline and task	Items	Score points	Understanding the arts in context	Developing practical knowledge in the arts	Developing ideas in the arts	Interpreting and communicating in the arts
DANCE	***(N=15)***	30				
A	4	9	X	X		X
B	3	6		X		X
C	4	7	X	X		X
D	4	8	X			X
DRAMA	***(N=21)***	31				
A	7	8	X	X		X
B	6	10	X	X		X
C	3	6		X		X
D	5	7		X		X
MUSIC	***(N=12)***	26				
A	5	13	X	X		X
B	2	3		X		
C	1	3		X		
D	4	7	X			X
VISUAL ARTS	***(N=14)***	25				
A	2	4	X	X	X	X
B	5	8	X	X	X	X
C	3	6	X		X	X
D	4	7	X	X	X	X

4. Example tasks

Component one: The Nature of the Arts (NoTA) assessment

Examples of NoTA tasks from each arts discipline are presented on the following pages. All four tasks were presented to students using a computer. The main features of each task are shown along with an example question (item) from the task. The task features provided include the curriculum strands associated with the task and the task stimulus material. For each item, the focus of the item is identified along with the scoring guide and examples of responses.

Dance

In the task called *Sāsā* (see Figure A8.1), students were asked to respond to four items about a media clip of a dance performance. Figure A8.1 shows that the second item explained that the dancers shown in the clip used their bodies in different ways to make sound, including clapping the palms of their hands together in front of their body. Students were then asked to 'Describe in detail **another way** they used their body to create sound'.

Curriculum Strand: **Developing practical knowledge in the arts**

Q2.
The dancers used their bodies in lots of different ways to create sound in this sāsā. One of the ways they did this was, they clapped the palms of their hands together in front of their body Describe in detail **another way** they used their body to create sound.

Samoan sāsā dance performance: Auckland Libraries Heritage Collections POLY-D-2015-167
(image substituted for video footage used in task)

Focus: **Identifies and describes movement features**

Scoring guide	Student responses
0 Inappropriate/limited response	'I don't know' 'clapping hands', 'hitting floor' 'shouting'
1 Simple description of a way in which sound is created	'hitting knees' 'stamping fist' 'smacking chest' 'calling out with voice' 'hitting ground with hands'
2 Clear/precise description of how specific body parts are involved in creating sound	'stamping fists across the ground to create a beat' 'in pairs tapping hands and elbows together' 'hitting thighs with palms of hands'

Figure A8.1 Item 2 of the NoTA task Sāsā

Drama

In the task called *Working in Role* (Figure A8.2), students were asked to watch a video where a person moves into role and then respond to five questions about it. Figure 2.3 shows the third item required students to describe how the actor used two drama techniques to tell the story.

Curriculum Strands: • **Developing practical knowledge in the arts** • **Communicating and interpreting**

Context: **In this activity you will be thinking about what people do when they are working in drama. You are going to watch a video where a person will move into role. That means they are going to pretend to be someone else. As you watch think about what this person is doing to show who they are pretending to be.**

Item 3. The actor used drama techniques to tell the story. The drama techniques the actor used were: Voice, Movement, Gesture, Facial expression, Use of space
Describe how the actor used two of these drama techniques to tell the story.

Focus: **Discusses meaning and intention, and how it is communicated**

Scoring guide	Student responses
0: limited description	"he changed his voice", "he acted like he was crying"; "he wrote/read a letter", "hand gesture", "clothes"
1: Simple description of technique/s connected to the story	"changed face/voice from sad to happy", "used pauses"
2: Describes a technique/s and connects them to the story	"finds a space to sit alone while writing the letter; hunched position shows he is unhappy; changed voice and emotion to a happier tone when he talked about the letters and cake from home; gesture of hand placed on pocket where photo is kept; gesture of holding letter to face to feel closer to those at home; he paused/hesitated when he talked about the battle as though he was worried; he took time to unfold the letter to build up suspense; his way of looking around as though paranoid of attack"

Figure A8.2 Item 1 of the NoTA task *Working in Role*

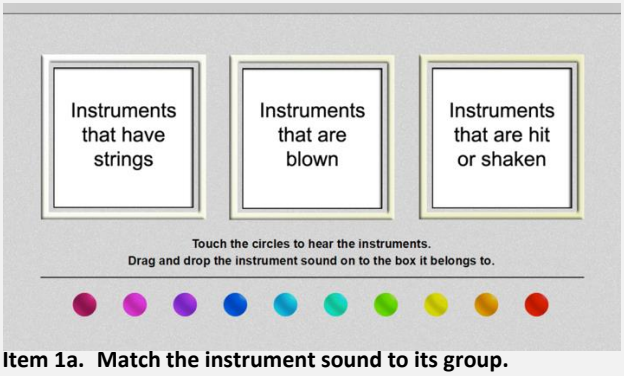
Music

Figure A8.3 shows a music task called *Instruments.* As part of the task, students were asked to answer two items. As can be seen in the figure, the first item required students to match the sound of a musical instrument to its picture.

Curriculum Strands: **Developing practical knowledge in the arts**

Context: **On the computer you will see three groups that describe instruments: instruments that have strings, instruments that are blown, and instruments that are hit or shaken.**

Listen to some instruments being played by touching the circles at the bottom of the screen. Drag and drop the instrument sound onto the group it belongs to.



Item 1a. Match the instrument sound to its group.

Focus: **Distinguishes between sound sources**

Scoring guide	Computer marked
0: No or weak understanding of concept	0-6 correct matches
1: Partial understanding	7-9 correct matches
2: Distinguishes sound sources - identifies how instruments are played	10 correct matches

Figure A8.3 Item 1 of the NoTA task Instruments

Visual Art

In a visual arts task called *White LEGO* (Figure 2.5), students were asked to respond to four items about a video clip and images of an artwork. Figure A8.4 shows that the first item required students to identify features of the process used to make the artwork.

Curriculum Strands:	**Understanding the arts in context** **Developing practical knowledge in the arts** **Interpreting in the arts**

Context:	**You will watch a video clip that shows an artwork called 'The Cubic Structural Evolution Project' by Olafur Eliasson. The picture also shows you this artwork. As you watch, think about what is interesting about the making of this artwork.**
Item 1.	What are two interesting things you notice about the making of this artwork?

Focus: **Demonstrates an understanding of convention, procedures and processes to make objects and images**

Scoring guide	Student responses
0: Inappropriate response or student is unable to respond	"I don't know"
1: Simple literal observation about the process	"It's made of white LEGO and there are a variety of shapes like tall buildings because it is a city"
2: Deeper understanding of the process	"The artwork can change because you can take it apart and rebuild it" (time-based aspect emphasised) "Adults and children participated in building it" (collaborative aspect emphasised)

Figure A8.4 Item 1 of the Nature of the Arts assessment task *White Lego*

Component two: Practical Tasks

Each of the four practical tasks was associated with one of the arts disciplines and involved students using practical skills to create an artwork. The tasks for dance and music involved the students collaborating with other students, while the task for drama involved them interacting with a teacher assessor. For visual arts, the students completed the task independently. Table A8.5 provides an overview of the four practical tasks.

Figure A8.5 Number of tasks and items in the NoTA assessment, by strand and discipline

Discipline	Task name	Focus
Dance	Creating a movement sequence	Students work with a partner to create a movement sequence that expressed words related to a picture.
Drama	Working in broken dream	Students work with a teacher assessor to play a role and reflect on the experience.
Music	Paper music	Students collaborate in a group to create a short piece of music using sounds made with paper.
Visual Arts	Draw, draw, draw	Starting from a picture showing part of a wing, students use a pencil to transform the wing into something new.

Appendix 9: Assessment framework for Te Reo Māori in the National Monitoring Study of Student Achievement 2021

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Tables:

Introduction

Ko te reo te mauri o te mana Māori

The language is the life force of mana Māori

- Sir James Henare

Te reo Māori is an official language of Aotearoa New Zealand. The group-administered Te Reo Māori (TRM) assessment has been developed by the National Monitoring Study of Student Achievement (NMSSA) primarily to monitor students' knowledge of te reo Māori in Year 4 and Year 8, in English-medium schools. This document locates the TRM assessment in relation to *The New Zealand Curriculum* (*NZC*) (Ministry of Education, 2007) and *Te Aho Arataki Marau mō te Ako I Te Reo Māori – Kura Auraki* (Ministry of Education, 2009), and provides an overview of the framework that has been used to guide the development of the assessment.

1. Te reo Māori in New Zealand curriculum statements

Te reo Māori is included in the Learning Languages area of the NZC. The aim of the NMSSA assessment is to assess aspects of the three inter-related strands of Learning Languages as they can be applied to te reo Māori:

- Communicative competence: the use of te reo Māori to engage in meaningful social interactions
- Language knowledge: the accurate use of te reo Māori, from the single-word level to more complex language structures
- Cultural knowledge: an awareness of cultural beliefs being expressed through te reo and tikanga Māori.

Te reo Māori differs from other learning areas in that there is no compulsion to teach te reo Māori to a specified level of proficiency in particular years in English-medium contexts. Therefore, a student's year level is not necessarily related to their knowledge of te reo Māori (arguably, a Year 1 and a Year 8 could be at the same point in learning te reo Māori).

Table A9.1 Summary of reference points in NZ curriculum statements, as applicable to the assessment of te reo Māori

The New Zealand Curriculum	**Learning Languages in The New Zealand Curriculum**	**Te Aho Arataki Marau mō te Ako I Te Reo Māori (selected achievement objectives)**	**Te Reo Māori assessment**
The Vision, Principles, and Values • confident • connected • actively involved • lifelong learners, etc. The Key Competencies • Thinking • Using language, symbols, and texts • Relating to others • Participating and contributing	Three strands: • Communication (the core strand): use the language to make meaning • Language knowledge (one of two supporting strands): how the language works, how it is structured, and adjusted for different contexts • Cultural knowledge (the second supporting strand): the inter-relationship between culture and language	Level 1: • Greet, farewell, and acknowledge people and respond to greetings and acknowledgments • Communicate about number, using days of the week, months, and dates • Use and respond to simple classroom language Level 2: • Communicate about relationships between people • Communicate about time, weather, and seasons	• Recognise appropriate responses to simple questions or complete missing words in sentences in te reo Māori • Identify equivalent sentences in te reo Māori and English • Write equivalent English words for te reo Māori words and instructions, and vice versa • Identify meaning of te reo Māori words in common use in New Zealand English ('loan words' such as aroha and kai) • Identify English equivalents of te reo Māori words (e.g., body parts, classroom objects), and vice versa • Identify the meaning of te reo Māori by selecting an appropriate graphic image • Identify English equivalents of te reo Māori words associated with tikanga Māori (e.g., visitors), and vice versa (e.g., kaumātua), including relationships (e.g., tuakana).

2. Building on the 2016 TRM assessment

Students' competency in te reo Māori was first monitored by NMSSA in 2016. The assessment developed for use in the 2021 study built on the assessment developed by NMSSA in 2016. The 2016 assessment was administered on computer using a suite of linked static tests that drew on a small bank of questions. NMSSA developed tests for Year 4 and Year 8 and used an Item Response Theory model to construct a reporting scale common to both year levels.

What we learnt from the 2016 TRM assessment

We had hypothesised that for many students, their knowledge of te reo Māori would be at the lower end of Level 1 of the learning progressions described in *Te Aho Arataki Marau mō te Ako I Te Reo Māori* (see Table A9.1). Items in the 2016 assessment, therefore, were targeted at curriculum level 1 (taumata 1). To differentiate degrees of attainment within taumata 1, scores on the TRM scale were divided into 4 achievement bands (wāhanga 1 to wāhanga 4). Each successive band represented an increasing level of achievement with taumata 1 content.

An analysis of the student data (see EARU & NZCER, 2017) showed that:

- Greater proportions of Year 8 students than Year 4 students achieved in the higher wāhanga.
- The majority of Year 4 students achieved at wāhanga 1 and wāhanga 2.
- The majority of Year 8 students achieved at wāhanga 2 and wāhanga 3.
- At both year levels, Māori students scored higher, on average, than non-Māori students.

Students who achieved high scores might not have had sufficient opportunity to demonstrate the extent of their te reo Māori. Therefore, for the 2021 TRM assessment, it was decided that more items at the upper end of the difficulty scale and at Level 2 of *Te Aho Arataki Marau mō te Ako I Te Reo Māori* should be included in the item bank.

Curriculum Advisory Panel review of the 2016 TRM assessment

In 2019, a group of languages experts met to review the 2016 assessment materials, including the TRM assessment. Their main recommendation relating to the TRM assessment was to limit English as the language of comprehension in the assessment. For instance, the amount ofEnglish in stems and instructions—aim to use images instead of words as much as possible. This was taken into consideration during the revision of the TRM assessment for 2021.

3. The 2021 TRM assessment

A decision was made to move from the static mode of delivery used in 2016 to a computer adaptive mode. The intention was to make it more possible to support a positive assessment experience for students with a range of levels of competence in te reo Māori. This decision meant that the number of available items across difficulty levels needed to be increased, particularly at the more difficult end.

Additional items

Additional items were added to the question bank. Some of these were selected from an existing online assessment, the Te Reo Māori Assessment, owned by NZCER. Items from the NZCER tool were selected on the basis of a combination of factors: difficulty level, type of item (items that involved no translation between te reo Māori and English were prioritised – see the first two bullet points below), and theme (e.g., family relationships, classroom objects, and social interactions). A second source of additional items were nineteen new open-ended items written specifically for the 2021 assessment by the NMSSA team. In total, 159 items were included in the bank of item used in the 2021 assessment.

Linking the 2016 and 2021 TRM assessments

An additional consideration involved maintaining links between the 2016 and 2021 assessments, to enable comparison of students' achievement over time. For this reason, 43 items were retained from the bank of items used in 2016. Items that did not perform well psychometrically in the 2016 assessment were not retained for 2021.

Structure of the TRM assessment

The algorithm underpinning the assessment administered each student a total of 20 items. The first 15 were selected-response items that were administered adaptively. In the adaptive section the student's responses were automatically marked and the achievement estimate updated after each response. After a response was scored, the next item administered was chosen from a pool of items with difficulty levels proximal to the latest achievement estimate. The algorithm also ensured that each student received at least 3 items from each of the 3 item types used to organise the selected response questions (English to Māori; Māori to English; and Māori to Māori—see Table A9.2 below). Once 15 items had been administered, the algorithm selected 5 short constructed response items that were closest to the achievement estimate calculated on the basis of the first fifteen items. These were then administered sequentially, with the student entering their answers in the spaces provided on screen. The algorithm was set so that most students would answer about half of the items administered correctly.

Making valid claims about the TRM assessment results

A conceptual assessment framework based on the NZC and *Te Aho Arataki Marau mō te Ako I Te Reo Māori*, was used to guide the design and development of the bank of assessment items (see Table A9.1). The claims and sub-claims associated with (expressed as main questions and sub-questions, respectively) shown in Table 2 are based on the three sub-strands of Learning Languages presented in the NZC, as they apply to te reo Māori. These informed decisions about the number and type of items to be included in 2021. The items included multi-option responses, short written responses, and selecting a graphic image that represents a given te reo Māori word or phrase. Table A9.1 shows how the strands and claims map onto item types in the assessment.

Table A9.2 Item map for the 159 items in the 2021 TRM assessment

Main questions To what extent are students developing:	**Related sub-questions** To what extent can students:	**Item types**					
		Selected response				**Short constructed response**	
		Respond in Māori to Māori, selected response (text)	**Respond to Māori, selected response (graphic image)**	**English to Māori, selected-response (text)**	**Māori to English, selected-response (text)**	**English to Māori, short written response**	**Māori to English, short written response**
Communicative competence in te reo Māori?	• recognise appropriate responses to simple questions or complete missing words in sentences in te reo Māori? • identify equivalent sentences in te reo Māori and English? • write equivalent English words for te reo Māori words and instructions, and vice versa?	1		6	1	20	20
Language knowledge associated with te reo Māori?	• identify English equivalents of te reo Māori words (e.g. identify meaning of te reo Māori words in common use in New Zealand English ('loan words' such as *aroha* and *kai*), body parts, classroom objects), and vice versa? • identify the meaning of te reo Māori by selecting an appropriate graphic image?	1	18	21	27		
Cultural knowledge associated with te reo Māori?	• identify English equivalents of te reo Māori words associated with tikanga Māori (e.g., *visitors*), and vice versa (e.g., *kaumātua*), including relationships (e.g., tuakana)?	5	7	17	15		

References

EARU & NZCER. (2017). *National Monitoring Study of Student Achievement: Learning Languages 2016 – Key Findings.* Dunedin: EARU, University of Otago.

Ministry of Education. (2007). *The New Zealand Curriculum*. Wellington: Ministry of Education.

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Appendix 10:
Assessment Framework for Technology

Contents:

Tables:

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Introduction

This appendix describes the assessment approach that the National Monitoring Study of Student Achievement (NMSSA) took to assess technology in 2021. It describes the technology learning area of the NZC and outlines the conceptual framework that guided the development of the Technological Literacy (TELI) assessment used by NMSSA to assess technology.

1. Technology in the New Zealand Curriculum

Technology was introduced as a learning area in the NZC in 1995, and updated alongside all other learning areas in the 2007 revision of the curriculum. In 2017, the learning area of technology was further revised to strengthen the positioning of digital technologies within the NZC. This change was substantial. It signalled the need for a greater focus on "students building their skills so they can be innovative creators of digital solutions, moving beyond solely being users and consumers of digital technologies."[10]

The technology learning area comprises three strands, which were unchanged in the 2017 revision. The strands provide an organising structure for the area and are integrated into teaching and learning programmes. The strands of technology are:

- Technological Practice: knowing how to plan for practice, develop and evaluate a brief and outcomes
- Technological Knowledge: knowing what key concepts underpin technological development and outcomes
- Nature of Technology: knowing why technology is influenced by (and influences) historical, social, environmental and cultural events.

The three strands of the learning area are embedded within five technological areas, which provide contexts for learning. Two of these areas reflect digital technology and were introduced in the 2017 revision of the learning area, while three remain unchanged. The technological areas of the NZC are:

- Designing and developing materials outcomes: developing knowledge and skills to form, transform and work with resistant materials, textiles and fashion
- Designing and developing processed outcomes: developing knowledge of the materials and ingredients used to formulate food, chemical and biotechnological products
- Design and visual communication: developing an awareness of design by using visual communication to conceptualise and develop design ideas
- Computational thinking for digital technologies: developing algorithmic thinking skills and an understanding of the computer science principles that underpin all digital technologies
- Designing and developing digital outcomes: developing understandings and skills for designing and producing quality, fit-for-purpose, digital outcomes.

Expectations of student achievement in technology are described in two ways. Achievement objectives structured around the eight levels of the NZC are associated with the three original technological areas, while progress outcomes describe the significant learning steps that students take as they develop expertise in the two technological areas associated with digital technology. Eight progress outcomes are provided for each of these areas with the first five unevenly spaced across levels 1 to 5 of the NZC.

2. The Technological Literacy (TELI) assessment

The TELI assessment was developed in 2016, and extended in 2021. It covers aspects of the three technology strands: technological practice, technological knowledge, and nature of technology. Note that some aspects of the technological practice strand relating to students making artefacts in authentic contexts could not be accommodated in the NMSSA programme.

Each of the three strands of the technology learning area contributes to the 'whole' of technological literacy. The technological practice strand enables students to undertake their own practice within a particular setting and to reflect on the technological practice of others. The technological knowledge strand provides students with a basis for the development of key generic concepts underpinning technological development and resulting technological outcomes. The nature of technology strand provides students with an ability to develop critical understanding of

[10] Te Kete Ipurangi (TKI) *https://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum/Technology*

technology as an intervening force in the world, and that technological developments are inevitably influenced by historical, social and cultural events. The values of NZC are embedded within these three strands.

A further aspect of technological literacy is students' ability to understand the inter-relationships between the strands and to be able to transfer conceptual understandings from the knowledge and nature strands into practice.

Technological literacy is not a term or concept that is unique to NMSSA. Technological literacy is acknowledged as being at the heart of technology education as described in the NZC, and enables students to live with, critique and contribute to technological developments that shape their lives.

To be technologically literate is to be able to:

- identify – say what, to indicate, spot or recognise (Level 1)
- describe – give details from own viewpoint (Level 1)
- explain – say why (Level 3)
- justify – give reasons, argument and evidence for a statement or judgement (Level 4).

Technologically literate young people:

- have a broad understanding of how and why things work
- understand how technological products and technological systems are developed
- can critically evaluate technological solutions and trends
- can design and evaluate their own solutions in response to needs and opportunities.

Table A10.1 outlines the construct that underpins the TELI assessment. The construct is divided into five aspects. Each of these are described and examples given of the knowledge, skills and understanding associated with the aspect.

Table A10.1 The TELI assessment construct

Aspect	Description	Examples
Communicate technological ideas	Demonstrate understanding of technology through identifying, describing, explaining, and justifying technology components, systems, and relationships.	• Identify (label) component parts of a system • Identify and describe key elements of a brief • Identify and describe needs and perspectives of stakeholders • Identify and describe purposes of functional modelling and prototyping • Identify and describe attributes and properties of materials • Identify and describe elements of technological systems including input, outputs, black box, transformations • Explain decisions • Explain how a technological development may have been influenced by historical social and/or cultural events • Explain relationships between components of systems
Show understanding of technological concepts through accurate and relational use of technological language	Use terminology and technological concepts with increasing accuracy in authentic technology contexts.	Use terms and concepts such as: inputs, outputs, transformations, brief, prototype, systems, black box, stakeholder, text, design, functional modelling, algorithm, sequence, loop, iterations, binary, bug, debug, and bot.

Aspect	Description	Examples
Understand core concepts of technology	Know how, know why and know that: Technology is about transformation ▪ transformations of energy ▪ transformations of information ▪ transformations of material. Technology involves manipulation, storing transport, and control in order to find solutions to identified needs and/or to realise opportunities. Prototyping and functional modelling are key to ensure fitness for purpose. Technology is intervention by human creativity to solve problems and enhance human capability.	• Identify non-technological and technological systems. • Identify steps in a technological process • Apply knowledge of design concepts and technological modelling to create desired, feasible outcomes that resolve real world issues.
Show developing understanding of the role of digital technology in solving technological problems.	Demonstrate practical knowledge of digital processes and their contribution to technological solutions through utilising computational thinking skills and design concepts.	• Code / give unambiguous step by step instructions • Identify digital devices and their purposes in unplugged and plugged contexts • Locate, analyse, evaluate and present digital information • Create digital content
Critique and evaluate (critical thinking)	Demonstrate critical thinking through analysing and evaluating effectiveness of technological solutions, and when considering the historical, cultural, and social impacts of technology. Evaluate the best tools/techniques to use to solve a problem in a digital and non -digital environment.	• Evaluate how well a design meets its brief. • Consider the impact of a technological solution on the stakeholders • Consider the impact of technological changes on society, on the future

3. Assessment of technology and curriculum coverage

The TELI assessment was a group-administered assessment. The technology indicators of progression[11] were used to provide the component for each item and for developing the associated marking rubric.

Table A10.2 presents the curriculum coverage matrix for the TELI assessment by strand and component. The shaded cells in the table indicate that aspects of the task (represented in each row) were associated with the component represented in the column.

[11] http://technology.tki.org.nz/Technology-in-the-NZC/Indicators-of-progression/Learning-Progression-Diagrams

Table A10.2 Coverage matrix for the TELI assessment by strand, component, and progress outcome

	Technological Practice			Technological Knowledge			Nature of Technology		Digital Technology	
TASK TITLE	Planning for practice	Brief development	Outcome development & evaluation	Technological modelling	Technological products	Technological systems	Characteristics of technology	Characteristics of technological outcomes	Computational thinking for digital technologies	Designing and developing digital outcomes
Bee Bot On the Move (Y4)**									■	
Binary Numbers (Y8)**									■	
Care Robot*						■	■	■		■
Coding the Stars (Y8)									■	
Corrector			■					■		
Doofer						■		■		
Drink Bottle		■								
Fit Fabric				■	■					
Hole Punch				■				■		
Is It Digital?**							■	■		■
Library Sorting System*						■	■		■	■
Mystery Object					■			■		
Ogo (Y8)				■			■	■		
Popcorn Maker						■		■		
Robot Dog**			■			■	■	■		■
School Sunhat*				■						■
Self-Driving Cars (Y4)**							■		■	
Self – Driving Cars (Y8)**							■		■	
Toothbrush Design (Y4)	■	■								
Toothbrush Design (Y8)	■	■								

* Tasks updated for the 2016 assessment

**Tasks new for the 2021 assessment

The TELI assessment contained a total of 15 tasks at Year 4 and 18 tasks at Year 8. Each task included a set of items based on one theme or idea. Descriptive criteria were used to mark each item. Questions were scored dichotomously (0 or 1) or using scales that ranged from 0 to 2, 0 to 3, or 0 to 4. Table A10.3 shows the breakdown of the number of tasks, items and score points for each strand in the TELI assessment.

4. Example of two assessment tasks

Two tasks from the TELI assessment are presented on the following pages. The main features of each task are shown (the curriculum strand/s, technological areas, and task stimulus material). Each task consists of several items. Examples of the questions students responded to, the scoring guide and possible student responses are illustrated.

Task: *School Sunhat*

The School Sunhat task was first used in the 2016 NMSSA study of technology achievement, and it was extended in 2021 to include elements of digital technology. In the task, students were told to imagine they have been asked to design a new sunhat for the students at their school. Their school wants the sunhat to provide protection from the sun, stay on and be comfortable to wear. The School Sunhat task contained five items. The first item required students to sketch and explain how the sunhat met the design brief (Figure A10.1). The second item required students to explain how using a computer might help a person when they design a sunhat (Figure A10.2). The third, fourth, and fifth items were new in 2021 and required students to design a digital solution to the problem of tamariki forgetting to wear their sunhats when they ate outside (Figure A10.3– A10.5).

Curriculum elements: **Technological Practice, Technological Knowledge, Designing and Developing Digital Outcomes**

Draw a sketch of a new sunhat for your school.

Item 1. On your drawing write notes to explain how the sunhat: **a) Provides protection from the sun**
b) Stays on
c) Is comfortable to wear

Component: **Describes design ideas (either through drawing models and/or verbally) for potential outcomes**

Scoring category	Example responses
0: No explanation about needs (a-c) outlined in the brief / Explains how design meets only <u>one</u> need outlined in brief / Inappropriate response	No labels on drawings
1: Explains how design meets <u>two</u> needs outlined in brief	"Padding for comfort." "SPF fabric to protect from the sun." "Velcro or hat in many sizes to stay on."
2: Explains how design meets <u>all three</u> needs outlined in brief	All of the above

Figure A10.1 Item 1 of the TELI task *School Sunhat*

Item 2. How might using a computer help a person when they design a sunhat?

Component: **Identifies the benefits and limitations of functional modelling undertaken in particular examples**

Scoring category	Example responses
0: Inappropriate response	"It is easier." "You don't need to sketch." "You can use an app/program."
1: General description	"Can change colours/size." "Quick to design." "Can see what design works best."
2: Detailed, specific description	"Shows finished product in detail." "3D – so can see it from many angles." "Made to scale – accurate measurements." "Use an app to simulate sun." "You don't waste materials."

Figure A10.2 Item 2 of the TELI task School Sunhat

Item 3.	Think of a way digital technologies, for example computers, apps, programs, could be used to remind the tamariki to wear their sunhats. a) Draw a labelled diagram to show your idea b) Explain how your idea works
Component:	**Designs a solution which includes the use digital tools or devices**
Scoring category	**Example responses**
0: Potential solution with no/limited explanation	"The teacher will tell us."
1: Non-digital solution with explanation	"Sunburn warning poster with levels of burn time."
2: Digital solution with no/limited explanation of how components are connected	"Hat has a microchip."
3: Digital solution with simple explanation of how it works	"Each student has a barcode in their sunhat which is scanned and beeps which allows them to exit classroom"
4: Digital solution with full explanation of how all components in the system connect	"An app on the student's phone is connected to the school timetable which sends a sunhat image to phone screen and vibrates when it is breaktime."

Figure A10.3 Item 3 of the TELI task School Sunhat

Item 4.	
Component:	**Designed solution includes linked digital components**
Scoring category	**Example responses**
0: Limited response	No labels on diagrams
1: Technological response	Digital devices or components are included and clearly labelled e.g. speaker, video, email, text, alarm, ipad, sensor.

Figure A10.4 Item 4 of the TELI task School Sunhat

Item 5.	
Component:	**Designed solution is described using digital technology process terms**
Scoring category	**Example responses**
0: Limited response	Uses everyday language e.g. reminder, sound, noise
1: Technological response	Solution is described using appropriate digital technology process terms e.g. data, pairing, interface, download, casting.

Figure A10.5 Item 5 of the TELI task School Sunhat

Task: *Self-Driving Cars (Year 4)*

The Self Driving Cars task for Year 4 students was one of several new tasks introduced in 2021 with a focus on digital technologies. Students were shown a short video clip about self-driving cars. The first part of the task focused on the Nature of Technology strand. It asked students to describe what is good and not so good about self-driving cars and describe possible societal impacts. The second part of the task focused on Computational Thinking for Digital Technologies and is shown below (Figure A10.6). It involved creating a set of step-by-step instructions to program a car's computer. Item one required students to write an accurate set of instructions (Figure A10.7). Item two required students to use appropriate coding conventions (Figure A10.8), and item three required students to identify that multiple sets of instructions can be used to solve the same problem (Figure A10.9).

Curriculum Strands: **Computational Thinking for Digital Technologies**

Sam needs to get from home to the supermarket in their self-driving car.

The car cannot drive through the shaded squares. It can't go backwards or diagonally.

Create a set of step-by-step instructions to program the car's computer, so that the car drives Sam from home to the supermarket.

The car needs to land in the supermarket square.

You can use the toy car to help you.

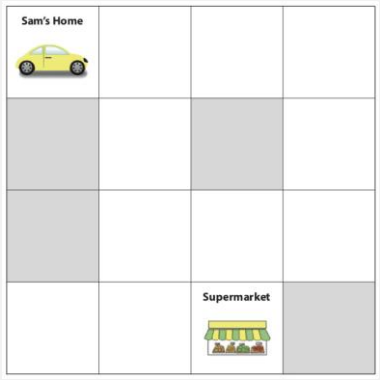

Figure A10.6 Part two of the TELI task Self-driving Cars (Year 4)

Item 1. **Create a set of step-by-step instructions to program the car's computer, so that the car drives Sam from home to the supermarket.**	
Component: **Provides accurate and unambiguous code**	
Scoring category	**Example responses**
0: Limited response	"Go from home and turn down towards the supermarket."
1: Code has a bug related to an incorrect number of steps	The counting includes the square where car is placed initially.
2: Code has a bug because turns are omitted	"Forward3, Down2, Forward1, Down1"
3: Code has a bug due to left/right confusion	"F3, turn right, F2, turn left, F1, turn left"
4: **Code is accurate with no bugs**	

Figure A10.7 Item 1 of the TELI task Self-driving Cars (Year 4)

Item 2. **Create a set of step-by-step instructions to program the car's computer, so that the car drives Sam from home to the supermarket.**	
Component: **Uses appropriate coding conventions**	
Scoring category	**Example responses**
0: No use of coding conventions	Directional arrows drawn into the grid provided Instructions written as a narrative.
1: Simple coding vocab is used: directional arrows, words or letters	"Forward, down, down, down, turn right, forward"
2: Repeat code is used to express algorithmic thinking	"Forward 1 square, turn right, forward 3 squares, turn left, forward 1 square "
3: Truncated repeat code is used consistently to express algorithmic thinking	"F3, R, F2, L, F1, L"

Figure A10.8 Item 2 of the TELI task Self-driving Cars (Year 4)

Item 3. **How many ways can Sam get from home to the supermarket? (Circle your answer)**
Component: **Identifies that there can be more than one algorithm for the same problem**
Scoring category
0: One
1: Two or three
2: Four

Figure A10.9 Item 3 of the TELI task Self-driving Cars (Year 4)

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Te Whare Wānanga o Otāgo
NEW ZEALAND

NZCER
Rangahau Mātauranga o Aotearoa

ISSN: 2350-3238 (Online only)

ISBN: 978-1-927286-73-9 (Online only)

New Zealand Government