PAT
Spelling Skills

Assessment framework

Contents

Tables

Introduction

The ACER Progressive Achievement Tests in Spelling Skills, *PAT Spelling Skills*, are a set of online spelling assessments that allow teachers to identify the extent of students' spelling skills in English, to diagnose gaps, identify strengths and weaknesses, and to monitor student progress over time. The assessments have been developed especially, but not exclusively, for use in Australian schools. The *PAT Spelling Skills* construct is appropriate for broad international use.

PAT Spelling Skills (2022) comprises twenty audio-based tests organised into five sets. Multiple tests of similar difficulty within a set provide flexibility to monitor spelling development before and after instructional interventions and allow teachers to conduct annual testing to measure longitudinal progress.

New features in the assessments allow for more authentic spelling tasks, including:

- the identification and correction of misspelled words;
- dictation, where students hear and then type in the correct spelling of a word;
- multiple-choice questions, where students hear and then select the correct spelling of a word;
- completing a word, where Early Years students hear a word and drop the missing letters into place.

Audio instructions make the tests accessible to students with limited reading skills.

The five sets of tests are of increasing difficulty, allowing teachers to select the tests that are most appropriate for students' level of spelling skill. The construct further expands the kinds of skills that are likely to support students' improved spelling.

PAT Spelling Skills is recommended for students from Foundation to Year 10. Very basic computer skills are required – use of a mouse or touchscreen for Early Years students, while some test items in higher sets require older students to correctly type words. The easiest tests suit students who have started to learn to spell, while the hardest tests have many words with challenging spelling.

PAT Spelling Skills is a substantially revised and improved set of spelling tests and the expanded scope of the new tests means a new spelling scale is required. The older *PAT Spelling* (2011) will remain available for schools choosing to continue tracking student progress on the previous spelling scale.

At the end of 2023, ACER reviewed the performance of the PAT Spelling Skills assessment. This validation exercise was made possible by an extensive dataset of nearly 100 000 tests completed by Australian students since the release of PAT Spelling Skills in March 2022.

Following the validation exercise, adjustments were made to the difficulty scale scores of some PAT Spelling Skills items, or questions. The updated scale score difficulties are reflected throughout this document and within the online reports.
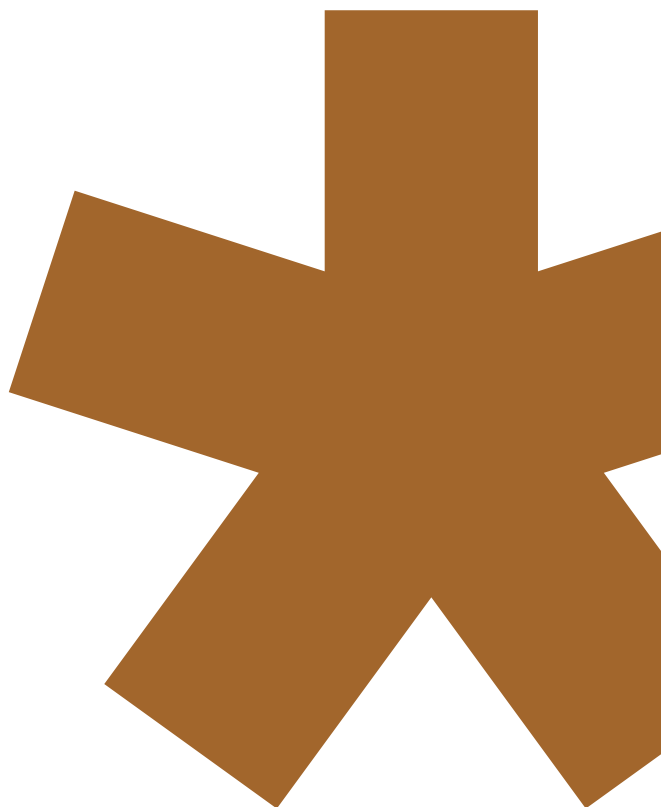
Rationale for PAT Spelling Skills

Standardised spelling is essential for effective written communication. Knowing how to spell supports critical capabilities such as reading with understanding and writing for meaning. It is a clear requirement of the Australian Curriculum that students learn to spell in standardised English. Spelling content descriptions are included at every level of the national English curriculum.

This sub-element describes how a student becomes increasingly proficient in selecting and arranging letters to form accurately spelt words. Students develop increasing skill and proficiency in using spelling as a tool to understand and create meaning in texts. At higher levels of the progression, students monitor their own spelling and explain how spelling impacts upon meaning.[1] (ACARA)

Spell checkers and predictive text have not made spelling skills obsolete. Automatic knowledge of the correct spelling for most words is necessary to allow the writer to focus on the meaning. Knowing how to spell a wide range of words supports students to confidently use these words in their writing and helps them to differentiate the meaning of similarly spelled words when reading. Spell checkers can support accurate spelling, but students must still have sufficient spelling skills, especially in knowing the initial letters of a word for the spell checker to predict the intended word. The student must also be able to recognise the word they were trying to spell when multiple options are provided by the spell checker.

Progressive Achievement approach

The Progressive Achievement approach provides a framework for integrating student assessment, resources that support teaching practice, and professional learning. PAT assessments allow teachers to collect evidence of student learning; to identify where students are in their learning at a given point in time; to monitor growth over time; and to reflect on student attainment. They provide reliable measures that enable a variety of interpretations about attainment and progress, such as:

- what students attaining specific levels of progression are likely to know, understand and be able to do;
- how much students have improved over time and what skills, knowledge and abilities they have been able to develop; and
- how a student's level of attainment compares with other students'.

The value of an integrated approach to assessment and student learning has become widely acknowledged. There is now a variety of formative, diagnostic assessment tools used in Australian classrooms. Summative assessments, such as NAPLAN, are often used to inform teaching and learning. As Dylan Wiliam (2011, p. 43) makes clear, 'any assessment is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers to make decisions about the next steps in instruction'. In his Report, David Gonski (2018, Finding 7) refers to the compelling evidence that 'tailored teaching based on ongoing formative assessment and feedback is the key to enabling students to progress to higher levels of achievement'.

ACER's PAT tests provide indicators of student achievement via scale scores and the accompanying achievement band descriptions. Upon completing their assessments, students are allocated a scale score that represents their ability in spelling skills. The scale is divided into achievement bands from which the skills and understanding represented at each level are described. The achievement bands therefore provide valuable evidence-based information about the skills students have achieved, are consolidating, and are working towards. As the Gonski Report recommends, reporting on assessment should have an emphasis on achievement and growth and that the growth should be measured against learning progressions (Gonski 2018, Recommendation 4). Masters (2013) also expresses the idea that learning should be assessed by measuring growth over time and against empirically derived learning progressions.

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1 https://www.australiancurriculum.edu.au/resources/national-literacy-and-numeracy-learning-progressions/national-literacy-learning-progression/writing/?subElementId=50968&searchTerm=spelling#dimension-content

The PAT reports provide targeted formative feedback, allowing student data to be sorted and analysed in a variety of ways. Using the PAT data and the achievement band descriptions, teachers can structure learning specifically to students' needs rather than where they are expected to be.

Progressive Achievement in Spelling Skills

There are many elements that contribute to the difficulty of spelling words in English, especially the extent of words with irregular spellings. But there are some general patterns that can be identified to support effective learning and teaching interventions.

Interrelated elements contribute to the increasing difficulty of spelling a word:

word length – from shorter to longer words

word frequency – from high-frequency words to less common and unusual words

phonetic complexity – from regular letter–sound relationships (eg some consonants) through to ambiguous relationships (eg vowels and vowel digraphs)

irregularities – from words that tend to follow rules or patterns in their irregularity (eg some instances of doubling letters) through to words where spelling must be learned

affix juncture complexity – from simple affix juncture rules with few exceptions to more complex juncture rules with exceptions

Spelling difficulty is multifaceted, depending on the extent to which the word matches the harder or easier end of each of the elements. Research shows that once students can represent all the sounds in a word with plausible letters, there is no clear hierarchy in the kinds of spelling errors they make. Poor spellers make the same kinds of errors as good spellers, the poor spellers just make more errors.

Progression in *PAT Spelling Skills* is supported by empirical data collected during trialling that shows the typical progression in difficulty of spelling the words in the assessments.

PAT Spelling Skills and curricula

The Australian national curriculum and all state curricula require students to use standardised spelling once they have learned to write. The national curriculum has content descriptors for spelling at every level of the curriculum.

Spelling is primarily taught in Literacy and Language subjects, but the skills are applied across all learning domains that involve reading and writing.

Broad alignment between the five sets of *PAT Spelling Skills* tests and the Australian Curriculum year levels is shown in Table 1.

Table 1 Broad alignment of PAT Spelling Skills sets to the Australian Curriculum

Sets	Spelling difficulty	Curriculum alignment
Set A	Letter skills and very short, regular words	Foundation–Year 1
Set B	Short, high frequency words	Year 1–2
Set C	A range of everyday words including polysyllabic words	Years 2–4
Set D	A wide range of less common words including polysyllabic words	Years 4–10
Set E	Unusual and challenging words	Years 7–10

Construct

Definition

A construct is a description of an ability that can be measured on a single dimension (with a single numeric variable). It often refers to 'what students know and can do'. A mathematical model is used to transform observations (eg student responses to test items) into measurements. A careful definition of ability/proficiency helps ensure that the assessment and reporting are consistent and legitimate.

The *PAT Spelling Skills* definition of spelling is the ability to correctly spell words in English. Spelling includes being able to hear and then spell a word, recognising the correct spelling of a word, and being able to identify and correct spelling errors. Spelling is in accordance with the 'Standard Australian English, Macquarie Dictionary', in line with the national curriculum.

Words with acceptable alternative spellings have been avoided. American spellings are not scored as correct.

Aspects

The *PAT Spelling Skills* construct is based on research about the typical development of spelling skills and the identification of useful diagnostic information that can help teachers to improve students' spelling. Most literature related to spelling skills refers to phonological, orthographic and morphological aspects of spelling, even though these terms are often loosely defined.

PAT Spelling Skills is based around these three aspects and uses the following definitions:

Phonological aspects refer to students' ability to hear all the phonemes in simple words and represent them with straightforward grapheme–sound relationships. It is concerned with plausible spelling based on hearing all the sounds in a word and knowledge of common, regular letter–sound relationships (mainly consonants and short vowels).

Orthographic aspects refer to knowing irregular word spelling, knowing a range of spelling rules for base words, knowing irregular forms of words and their spelling (eg irregular plural, past tense), recognising legal and illegal letter combinations, and knowing a range of more complex phonic letter–sound relationships relevant to spelling.

Morphological aspects refer to knowing how the morphemes (elements of meaning) in a word affect spelling as well as the word form or meaning. This includes knowing affix juncture rules, and recognising how root words support spelling.

Structure

The *PAT Spelling Skills* construct is the organising principle of the assessment; it is used to guide test development and structure the PAT reports. This structure is also part of the Progressive Achievement approach because the knowledge, skills and understanding represented in the assessments is designed to support educators in identifying student learning needs.

Word types

Recent findings have highlighted the important role of morphology in supporting spelling development along with phonological skills and understanding orthographic aspects of words.

A **morpheme** is the smallest unit of meaning in a word. **Base words** are free morphemes that cannot be broken into smaller meaningful units. English spelling of free morphemes tends to be consistent across different, but related, forms of the word created by the addition of an affix (eg like, likely, likeness, dislike), as well as when the base meaning is carried across but modified (eg unlikely). Spelling of irregular base words is also supported through knowledge of word roots and word origin.

Affixes are bound morphemes. They are only meaningful when attached to a base word. Affix juncture rules about the effect of spelling when attaching an affix tend to be simple in English, though there are exceptions. If students know how to spell a base word and know a range of affix juncture rules and common exceptions, they are likely to be able to spell other related words with the same base.

PAT Spelling Skills distinguishes four word types:

- Simple base
- Simple base with affix
- Complex base
- Complex base with affix

Each of these word types relate to one of the three aspects of spelling that are most commonly identified in the research literature.

Table 2 *Conceptual aspect for each word type*

Word type	Conceptual aspect
Simple base	**Phonology:** This means focusing on common regular sounds of consonants and short vowels. Phonology begins with phonemic awareness and letter–sound knowledge, moving to phonetically plausible representations of sounds, and then accurate representation of all sounds in a word.
Simple base with affix	**Morphology:** Affix juncture rules are applied where the base word spelling is regular, so attention is on the juncture rules and their exceptions. At higher bands the focus is on less common examples including more unusual exceptions to affix juncture rules.
Complex base	**Orthography:** This includes recognising words by sight, knowing a range of spelling rules for base words, knowing irregular forms of words (eg plural, past tense) recognising legal and illegal letter combinations, and knowing a range of more complex phonic letter–sound relationships relevant to spelling.
Complex base with affix	**Morphology:** Affix juncture rules are applied where the base word spelling is not straightforward. This includes base words with irregular forms such as plurals and past tense (eg *gone* is classified as a complex base with an affix as the conventional 'ed' to indicate past tense is not applied here). Knowing root meanings and recognising foreign words also provides support for spelling.

The purpose of differentiating between simple base and complex base is to provide diagnostic support to teachers to identify if students can apply basic phonological knowledge to plausibly represent all the sounds in a word. Research shows that this basic level of phonological skill is the first step in spelling development. Complex base words cover all other non-regular spellings. Research also shows that there is no clear hierarchy of skill development. There are many ways in which word spelling may be complex including across very common words. Students need to learn a range of skills including simply knowing how to spell some irregular words.

The purpose of differentiating between simple base words with an affix and complex base words is to provide diagnostic support to teachers to identify if students know the affix juncture rules when the base word spelling is simple, compared with knowing both complex base spelling and affix juncture rules.

The focus for each of the word types varies across the tests as the spelling words become more difficult. The easier tests have a greater focus on regular base spelling words and simple affix juncture rules with some high-frequency complex words. The harder tests have a greater focus on complex base spelling words and more complex affix juncture rules and exceptions.

Item types

There are four item types in *PAT Spelling Skills*:

Complete the word items require students to hear the word and then drag and drop the missing letter or letters in a short, simple word.

Listen and spell is a dictation task. Students hear the word, hear it in a sentence that supports common usage of the word, hear it again and then type it. Where homonyms are used, the sentence clearly supports the meaning of the word.

Selecting the correct spelling involves identifying which of four options is the correct spelling of a word.

Correcting the misspelled word items include identifying the incorrect word in a sentence with about five words of the same difficulty as the misspelled word. Students then type the correct version into the answer box. No clues are provided about which word might be incorrect.

Apart from selecting the correct spelling, which is multiple-choice, all other item types require students to generate the correct spelling using their keyboard or touchscreen. This provides a range of authentic spelling contexts.

Assessment design

PAT Spelling Skills consists of twenty tests organised into five sets of increasing difficulty:

Set A: Tests A1, A2, A3, A4

Set B: Tests B1, B2, B3, B4

Set C: Tests C1, C2, C3, C4, C5, C6

Set D: Tests D1, D2, D3, D4

Set E: Tests E1, E2

The tests within a set are organised into pairs of pre- and post-tests of approximately similar difficulty. In each set, tests 1 and 2 are the easier pair, with 3 and 4 slightly harder and 5 and 6 slightly harder again. The exception is Set E, where test 2 is considerably harder than test 1, allowing teachers to challenge good spellers.

The reason for providing many tests across five different sets is because spelling skills can be improved over a few months with sustained, effective, and intensive instruction. Additional tests allow teachers to measure change after six months if they have implemented this kind of focused spelling instruction.

Set C contains a greater number of tests because these are the levels of spelling difficulty that are appropriate for the greatest number of students.

Measuring the construct

In developing items and designing the tests, several major criteria were considered:

- distribution of items across word types
- distribution of item types
- distribution of item difficulty

These considerations were applied within each test, within each set of tests, and across the sets.

Distribution by word type and item type

Table 3 (p 8) shows the percentage of items distributed across each of the tests by word type and by item type. Word types with affixes have been combined in this table.

Table 3 *Percentages of PAT Spelling Skills items by word type and item type for each test*

Test level	Word type %			Item type %			
	Simple base	Complex base	With affixes	Complete the word	Select the correct spelling	Listen and spell	Correct the misspelled word
Test A1	77	23	7	80	20		
Test A2	63	37	3	80	20		
Test A3	80	23	0	80	20		
Test A4	70	30	7	80	20		
Test B1	37	63	13		50	50	
Test B2	40	60	10		50	50	
Test B3	43	57	7		50	50	
Test B4	40	60	13		50	50	
Test C1	23	77	30		33	33	33
Test C2	23	77	43		33	33	33
Test C3	17	83	40		33	33	33
Test C4	23	77	43		33	33	33
Test C5	23	77	37		33	33	33
Test C6	10	90	40		33	33	33
Test D1	23	77	73		27	40	33
Test D2	17	83	70		23	40	37
Test D3	13	87	70		27	40	33
Test D4	17	83	77		23	40	37
Test E1	3	97	66		30	37	33
Test E2	0	100	66		30	37	33

Distribution of item difficulty

It is important to have a spread of item difficulties that match the abilities of the students. Where there are sufficient items, there is also a range of difficulty within a word type and item type in each test. There is considerable overlap in difficulty of the tests, especially within a set, as well as overall progression in difficulty across the tests.

Each test stands alone, with items of a wide range of difficulty and no common content. The numbering of sequential tests indicates increasing difficulty and are not matched to year levels.

Table 4 shows the mean difficulty of the items in each of the *PAT Spelling Skills* tests in scale score units, with their standard deviations. Standard deviation measures the amount of variation in item difficulty for a set of items.

Table 4 *Mean difficulty and standard deviation of each PAT Spelling Skills test*

Test level	No. of items	Mean item difficulty (scale score)	Standard deviation (scale score)
Test A1	30	87.2	6.7
Test A2	30	89.8	6.7
Test A3	30	92.5	6.6
Test A4	30	94.4	7.3
Test B1	30	102.6	12.7
Test B2	30	105.5	12.8
Test B3	30	109.3	15.7
Test B4	30	109.7	15.8
Test C1	30	121.1	15.7
Test C2	30	123.1	16.6
Test C3	30	125.0	16.4
Test C4	30	125.4	15.5
Test C5	30	131.3	13.9
Test C6	30	133.2	14.6
Test D1	30	138.5	13.4
Test D2	30	138.4	13.2
Test D3	30	142.3	10.4
Test D4	30	142.5	11.5
Test E1	30	146.3	12.7
Test E2	30	154.1	9.8

Delivery

Choosing the right test

Planning and consistency are important in ensuring *PAT Spelling Skills* is used effectively and that students' results are useful and meaningful.

Students need some very basic computer skills. For tests in Set A, students will respond to multiple-choice and drag-and-drop items, which can be done with a mouse or on a touchscreen, but for Sets B–E students must also be able to use a keyboard (virtual or physical). Two-thirds of items in the tests in Sets B–E require students to enter text to spell a word.

The five *PAT Spelling Skills* sets each target a general stage in spelling development. The sets are not aligned with year levels as the range of spelling skills in any year level can vary widely.

Set A: letter skills

Set B: short, high-frequency words

Set C: polysyllabic everyday words

Set D: polysyllabic less-common words

Set E: unusual and challenging words

Set A is appropriate for students who have started to spell some simple words with three letters or fewer.

Sets B to D are appropriate for primary and secondary students depending on their level of spelling skill and the extent of their vocabularies.

Set E targets students with good spelling skills and wide vocabularies, typically mid-secondary and higher. It focuses on complex spelling including unfamiliar words and many words considered to be 'spelling demons'.

The sets are designed to support teachers to select appropriate tests that match students' current spelling skills. This structure also helps to give teachers a broad understanding of the spelling needs of their students.

There are multiple tests within each set. This recognises that after Set B, students' spelling progress is likely to be slow as there are many complexities to learn in spelling words in these sets. Tests in Set C are likely to be appropriate for the same students for several years. Tests in Set D are also likely to be appropriate for several years. Within each set, the 1 and 2 tests are the easiest, and the 3 and 4 tests are more difficult.

Frequency

For the purpose of monitoring student progress by PAT scale score, a gap of 9 to 12 months between testing sessions is recommended. Learning progress may not be reflected in a student's scale scores over a shorter period of time. Longitudinal growth should be measured over a minimum of two years of schooling, or three separate testing sessions, in most contexts. This will help account for possible scale score variation, for example where external factors may affect a student's performance on a particular testing occasion.

If students are making great strides in their learning, more frequent testing may be warranted. As spelling is a discrete skill that can be improved with sustained intervention, multiple tests are provided within a set to allow teachers to test after half a year. This is only recommended where there has been a focused spelling program.

Test administration

Teachers are required to supervise test administration. Headphones are required by all students. Practice items are embedded to support administration of the tests. The recommended test administration time is 20 minutes. Consistency in the time allowed to students will assist teachers in comparing the results of students.

Item response formats

Items are multiple-choice or text-entry. Audio prompts are provided for dictated spelling words and words where the correct spelling must be identified.

Set A: All items are multiple-choice or drag-and-drop, to avoid young students needing to use a keyboard. Students complete the spelling of a word they hear by adding a letter using drag-and-drop functionality or by selecting the correct spelling of a word.

Set B: Half the items are text-entry, requiring students to listen and spell a dictated word. The other half are multiple-choice, requiring students to select the correct spelling of a word they hear.

Sets C and D: One-third of the items require students to listen and spell a dictated word. One-third are multiple-choice and require selection of the correct spelling of a word they hear, and one-third are editing tasks where they must identify the incorrect word in one sentence of text and enter the correct spelling for that word.

Set E: As for C and D, but for the editing tasks there may not be a spelling error, in which case students must enter 'N' to indicate no error.

Reporting

The information provided by the *PAT Spelling Skills* reports is intended to assist teachers in understanding the extent of students' spelling skills, diagnosing gaps, strengths and weaknesses, and measuring learning progress over time.

PAT scale score

A PAT scale score is a numerical value given to a student whose achievement has been measured by completing a PAT assessment. A student's scale score lies at a point somewhere on the specific PAT scale, and it indicates that student's level of achievement in that learning area – the higher the scale score, the more able the student.

Regardless of the test level or items administered to students, they will be placed on the same scale for the learning area. This makes it possible to directly compare students' achievement and to observe students' progress within a learning area by comparing their scale scores from multiple testing periods over time.

Item difficulty is a measure of the extent of skills and knowledge required to be successful on the item. This makes it possible to allocate each *PAT Spelling Skills* test item a score on the same scale used to measure student achievement. An item with a high scale score is more difficult for students to answer correctly than an item with a low scale score. It can generally be expected that a student is able to successfully respond to more items whose difficulties are located below their achieved scale score than above.

By referencing the difficulty of an item, or a group of items, and the proportion of correct responses by a student or within a group, it may be possible to identify particular items, or types of items, that have challenged students.

A score on the *PAT Spelling Skills* scale has no meaning on the older PAT Spelling scale, or any other PAT scale. The units of the scale have different meanings for each scale. This is because these units are calculated based on the range of student levels of achievement, which vary widely.

Achievement bands

While a scale score indicates a student's achievement level and can be used to quantitatively track a student's growth, it is only in understanding what the number represents that teachers can successfully inform their practice to support student learning. For this reason, the PAT scale has been divided into achievement bands that include written descriptions of what students are able to do at that band (band description). A student scoring in a particular band can be expected to have some proficiency in that band and be progressively more proficient with the spelling skills outlined in lower bands.

Students in the same achievement band are operating at approximately the same achievement level within a learning area, regardless of their school year level.

Viewing student achievement in terms of achievement bands may assist teachers to group students of similar abilities. By referencing the PAT achievement band descriptions, teachers can understand the types of skills typical of students according to their PAT band.

A *PAT Spelling Skills* scale score of 150 could be considered to be at the upper end of achievement band 140–149 or at the lower end of achievement band 150–159. In cases like these, it is important to reference the descriptions of both achievement bands to understand the student's abilities.

Table 5 *PAT Spelling Skills achievement band descriptions with some examples of words for each band*

PAT Spelling Skills achievement band descriptions	
170 and above	Students at this level can spell, identify and correct mistakes in very difficult and uncommon words (eg subconscious, perseverance).
160−169	Students at this level can spell long words with repeated sounds spelled differently (eg insufficiently). They can identify and correct misspellings of long, irregular and challenging words with affixes (eg bureaucracy).
150−159	Students at this level can spell longer, less familiar words with challenging vowel combinations (eg reasonable). They can identify longer words with inconsistent affixes (eg particularly). Students can correct misspellings of challenging words with affixes (eg inconceivable).
140−149	Students at this level can spell words with non-phonetic spelling (eg luggage). They can identify the correct spelling of longer words with challenging affixes (eg independence). Students can correct misspellings of long and irregular words with affixes (eg assistance).
130−139	Students at this level can spell words with difficult vowel combinations (eg opinions). They can identify the correct spelling of longer words with affixes (eg disagreement). Students can recognise errors in words with non-phonetic spelling (eg bought).
120−129	Students at this level can spell challenging one-syllable words and regular polysyllabic words (eg whole). They can identify the correct spelling of difficult, long and irregular words (eg replies). Students can identify and correct misspellings of longer, compound and irregular words (eg statement).
110−119	Students at this level can spell regular, short words, some with affixes (eg lunch). They can identify the correct spelling of longer words with regular affixes, and they are beginning to be able to identify compound words (eg afternoon). Students can identify and correct some misspellings in regular words of about seven letters (eg finally).
100−109	Students at this level can spell common words that are fairly regular and short, without affixes (eg crawl). They can identify the correct spelling of longer words which may have irregular spelling or with affixes (eg running).
90−99	Students can identify the correct spelling of one-syllable words with blended letters or irregular spelling (eg identify the ck in lock). They can spell one-syllable words with regular spelling, including regular affixes such as '-ed' (eg called).
80−89	Students at this level can identify letter sounds in frequently used, phonetic words of up to five letters (eg identify the oo in good). They can identify the correct spelling of phonetic words of up to five letters, including some regular affixes (eg deep).
79 and below	Students at this level can identify letter sounds in very frequently used, phonetic words (eg identify the i in big). They can identify the correct spelling of simple words up to three letters (eg top).

Reference groups

PAT Spelling Skills reference groups will be available in the future as a reference sample against which student achievement can be compared. They will be composed of Australian students in Years 1 to 10 who have completed *PAT Spelling Skills* once sufficient response data is collected.

Appendixes

Appendix 1

Literature review: locating PAT Spelling Skills in the broader research context

Introduction

Spelling is integral to becoming literate. There is a strong reciprocal relationship between learning to read and learning to spell and write (Berninger et al. 2002; Conrad 2008; Ehri 2000; Castles et al, 2019). This is an iterative process as learning to read informs learning to write and spell, which in turn supports learning to read.

Spelling skills development

Research on spelling skills development reveals evolving perspectives of increasing complexity that no longer endorse simple stage-based theories. There is general agreement about the three aspects that underpin spelling:

- phonology
- orthography
- morphology

Previously, stage theories (Marsh et al.1980; Gentry, 1982; Frith,1985) suggested that children begin spelling based on sounds and gradually move to a greater consideration of orthography and morphology. Recent research has contested this belief, instead seeing the development of spelling as a non-linear process in which learners become increasingly efficient in the use and coordination of phonological, orthographic and morphological knowledge, concurrently drawing on all of these skills to a greater or lesser degree (McMurray, 2020; Treiman et al, 2016; Berninger et al. 2010, Bourassa, 2001).

Novice spellers typically master plausible representation of all the phonemes in a word within a few years of instruction. Mastering more complex elements of phonology and acquiring a depth of knowledge of orthography and morphology takes considerable time, with much still being learned well into secondary school (Arndt & Foorman 2010).

The interrelationship between phonology, orthography and morphology can confound attempts to isolate the impact of any one aspect on spelling errors. Contemporary approaches advocate integration. McMurry (2006) found significant gains in learning to spell can be achieved by all students when an integrated approach to instruction is adopted that includes consideration of phonological, orthographic and morphemic elements of spelling. Daffern (2015) also advocates that spelling assessments should consider these three aspects in the selection of words for assessment.

Spelling complexity and errors

Shorter words are easier to spell than longer words. For novice spellers, more letters make a word harder to spell. For more experienced spellers, more syllables, rather than letters make a word harder to spell. Concrete words also tend to be easier to spell than abstract words (Sadoski et al. 2004).

There are conflicting research findings about developmental patterns of spelling errors. Arndt and Foorman (2010) found that the lowest performing quartile of Year 2 students generated the same pattern of spelling errors as the rest of the students, they just made more of them. The errors were phonological, orthographic and morphological. They identified ten spelling pattern errors with most error occurring for doubling rules, changing rules, irregular plural nouns, and r-controlled and past tense 'ed' patterns. Along with Stage & Wagner (1992), they also identified that long and short vowel spelling patterns were particularly difficult for poor spellers. Ganske (1999) identified that the first stage in learning to spell is plausible phonemic representation. After that, students learn patterns that occur within words, such as vowel-consonant-'e' (eg state, abate, later), r-influenced vowels (eg corn, barn) and vowel digraphs (eg pie, blue) were typically mastered by 12 years of age. Syllable juncture (eg adding a consonant at the end of a word can change the pronunciation: table to tablet, sign to signal) and derivational constancy rules (eg 'pre-' means before in predict, presage and previous) were only partially mastered by this age.

The nature of the spelling task also affects difficulty. For primary students, recognising the correct spelling of a word is typically easier than generating the spelling (Critten et al., 2013). Unsurprisingly, these tasks are highly correlated, meaning performance on one task is likely to predict performance on the other task (Allred, 1984). Proofreading to identify spelling errors is more difficult than dictation. Proofreading that includes error correction is harder again, and less highly correlated with dictation skills. This suggests that factors other than spelling may affect editing skills (Daffern et al 2017).

Phonology (sound-based spelling)

Sound-based spelling strategies require the ability to hear all the sounds in spoken words and know the written symbols that represent these sounds. Once the alphabetic principle is established, students can spell phonetically regular words (Daffern, 2015; Zhao et al., 2017).

Phonemic awareness is the ability to segment spoken words into phonemes, which are the smallest sounds in English. Phonics refers to the alphabetic knowledge required to match phonemes to a corresponding grapheme (letter or letters). Phonics is fine-grained. It is focused on phonemes (single sounds) within words that may be represented by single letters, digraphs (two letters, eg 'th') and trigraphs (three letters, eg 'tch'). Phonics is complex – in English, there are 26 letters, which are used singly and in various combinations to represent 44 phonemes. This includes many ambiguous letter–sound relationships, especially for vowels. But there are sufficient phonetically regular words as well as common phonetic rules to make phonics knowledge essential for both reading and spelling.

In their meta-review of the research literature on reading, Castles et al (2019) identify extensive research evidence of the efficacy of systematic phonics instruction in early reading, writing and spelling. There is ongoing debate about the most effective methods and extent of systematic phonics instruction. There is also uncertainty about whether this should be limited to individual graphemes and phonemes and their most common mappings or extended beyond this. Castles et al suggest more systematic research is required to identify the optimum number and complexity of phonics rules that need to be taught (Castles, 2019, p. 14).

There are typical developmental patterns in the early acquisition of phonics-based spelling skills. Consonants are typically easier to learn to spell than vowels (Treiman et al, 1994). Initial and final consonants most easily mastered with beginning blends, short vowels, including medial vowels and final blends of similar difficulty for six-year-olds and typically largely mastered by nine-year-olds (Ganske, 1999).

Orthography (sight-based spelling)

When preschool children are exposed to written words that they can follow as the words are read aloud, they become highly sensitised to familiar visual (orthographic) features of the words (Treiman, Kessler, Pollo, Bryne, & Olson, 2016; McMurray, 2006).

Sight-based spelling strategies involve recognising that the spelling of a word 'looks right', based on visual cues as well as the recognition that certain sequences of letters are legal and others are illegal (eg 'ough' is legal, but 'ouhg' is not). Classification of orthographic components of words vary and may overlap with phonology. Daffern and McKenzie (2015) include common letter patterns such as vowel-consonant-silent 'e' (eg make), complex consonant clusters (eg 'str'), syllable juncture consonants that are often doubled (eg bottle) and unaccented final syllables (eg tunnel). They also include less-common digraphs and trigraphs as orthographic components, which others might argue should be considered as phonology. Orthographic rules about legal letter sequences also apply to morphology as suffixes, prefixes and word roots.

Bourassa and Treiman (2014) consider the development of an understanding of orthographic rules to be critical from the early stages of learning to spell. Phonological awareness developmentally precedes phonemic awareness, but it has a role in the early development of orthographic strategies as these focus on larger elements of words than phonemes, such as syllables. Frequent exposure to the correct spelling of words, including many common, phonetically irregular words, as well as explicit identification of rules, visual patterns and legal letter strings, is also key to building orthographic knowledge (Bosman & Van Orden, 1997). Exposure alone is insufficient. Good readers are not necessarily good spellers, suggesting they may not learn to notice patterns in orthographic or morphological features of words unless these are explicitly pointed out.

Morphology (meaning-based spelling)

Morphemic spelling strategies involve recognising the smallest parts of written words that are meaningful (morphemes) and how these affect spelling. Morphemes include prefixes, suffixes and roots. Morphological awareness refers to knowing how morphemes can carry and alter meaning.

Base morphemes, also known as free morphemes, are meaningful independent units. Spelling of base morphemes tends to be consistent in English, when a morpheme carries meaning across a range of words. (Devonshire et al., 2013). For example, 'like' is the base morpheme and retains this spelling for likeness, unlikely, dislike and likeable. Teaching the spelling of base words including roots in the context of developing a rich, broad vocabulary as well as recognising the range of words that carry the base, or root meaning, also supports strong connections between spelling and word meaning.

Suffixes and affixes are typically bound morphemes and cannot be used as isolated words. They affect the meaning or grammatical form of words. Young first language speakers have already acquired extensive morphological awareness of common affixes by the time they start school, such as knowing that a noun can be made plural by adding 's'. They demonstrate this awareness in their speech and then transfer it to their spelling, gradually acquiring refinements. For example, they learn to replace 'y' with 'i' to make 'fly' into 'flies' and then to extend this rule when applying other suffixes so 'happy' becomes 'happily', or 'happiness'. Understanding Latin and Greek roots and how these affect meaning is typically developed later, as students become skilled readers and writers.

Morphological awareness has a powerful influence on spelling as well as word-level reading and reading comprehension development (Apel, 2014; McCutcheon et al., 2008; Bowers et al., 2010; Goodwin & Ahn, 2013). The role of morphology in spelling is recognised in most English literacy curricula, but teacher knowledge of how morphemes communicate meaning, how this governs spelling, and how to teach these skills is often limited (Hurry et al., 2005).

Some researchers suggest that morphological instruction should begin at the earliest stages of learning to read before alphabetic principles are firmly established (Bowers et al, 2017; Devonshire, 2013). Developing morphological awareness through instruction and practice in the way familiar suffixes and prefixes (eg 'ed', 'ing', 'ly') are used in students' speech will support them later when they develop sufficient writing skills to spell words that use these very common bound morphemes.

Disagreements about beginning morphological instruction early may be more about whether the instruction is focused on oral language skills or reading. Masterton's (2010), analysis of printed word frequency shows that in the first year of reading instruction, texts students read consist overwhelmingly of single-morpheme words. For early reading, it would seem sensible therefore to focus on spelling-sound relationships initially and to promote morphological awareness as students start to read words with multiple morphemes (Rastle, 2018).

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Appendix 2

Trial design and assessment validity

PAT Spelling Skills items have been rigorously trialled in Australia, to empirically identify the difficulty of items. The items from all the tests have been scaled on the new *PAT Spelling Skills* scale to allow for monitoring student progress over time. All items are developed by a group of experienced test developers specialising in spelling skills, who review and panel the items until they are ready for trial. A rigorous process of quality checking, proofreading and formatting then takes place. The psychometric team provides a trial design based on the items (distribution of strands and item type).

To ensure the most valid and reliable psychometric data is made available, items are currently trialled in standalone trial test forms. Sets of items are placed into different locations in multiple versions of a single test form. Schools using any of ACER's online PAT assessments may opt for their students to participate in the test trials. Data analysis is performed after trial by the psychometric team, with the Test Development Manager making final decisions about item performance and deletions. Each trial is designed to strengthen the construct, ensuring a spread of items along the PAT scale that meets the demands of strand and proficiency distribution.

A test is said to be valid if it measures what it was intended to measure. The *PAT Spelling Skills* tests were planned and constructed to assess spelling skills of increasing complexity in authentic contexts for spelling through dictation and editing. In constructing the tests, care is taken to include a range of all appropriate characteristics to ensure that the breadth of students' abilities can be captured. All items are subjected to intensive scrutiny, review and revision by panels of experts.

The test calibration procedures identify items that appear to be measuring skills other than those measured by the majority of items. Items 'misfitting' in this way are not retained. The items retained for *PAT Spelling Skills* have been shown to fit the Rasch measurement model satisfactorily. Items that are not able to discriminate between high and low performing students were not selected for *PAT Spelling Skills*. All selected items can be regarded as measuring a student's location on a single underlying continuum of Spelling Skills.

Appendix 3

PAT Spelling Skills item type examples

Complete the word

Word: tap

> Drag the letter to make the word ...
>
> ☐ ap
>
> l   t   g   c

Select the correct spelling

Word: bag

> Which word spells ...
>
> sag   pad
>
> bad   bag

Listen and spell

> Type ...
>
> [   ]

Correct the misspelled word

One of these words is spelled incorrectly. Type the correct spelling in the box.	She sat quietly on her towel and looked at the waves on the beech. [ ]

The item format below only appears in Set E. There may not be a misspelled word at this level.

One of these words **may** be spelled incorrectly. Type the correct spelling in the box. If there is no error, type N in the box.	The saltwater crocadile is the largest living reptile. [ ]