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Secondary Curriculum Literacy and Teacher Word-Knowledge: Further Findings from a Western Australian ITE Cohort Study

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Abstract: The Australian Government, in its Professional Standards for Teachers and Australian Curriculum framework, requires that all secondary teachers actively teach the specific literacy of their learning area. Yet achievement of that goal hinges on teachers having first acquired the pre-requisite literate competencies during their own schooling. There are reasons to doubt that this is the case for some graduate teachers, which means attempts to raise standards in schools are beset by a troubling circularity. Here we illustrate the problem with further findings from a Western Australian ITE Cohort Study (n=393), focussing this time on the word knowledge of secondary teaching graduates. Our analysis suggests that some secondary ITE students carry shortcomings from their own schooling that may hamper their ability to teach word knowledge or to self-correct. Current training and resources may thus have limited efficacy for some graduating teachers, placing limits on what can be achieved in schools. We consider the implications for literacy policies and for initial teacher education at secondary level.

Key words: teacher literacy, literacy pedagogy, secondary curriculum, subject vocabulary

Introduction

Previously we have reported the findings of a large cohort study investigating the literacy skills of secondary teaching graduates and their capacity to teach discipline literacies in specialist learning areas (Moon, Harris & Hays, 2019). In that study, a sample of 393 undergraduates enrolled in Bachelor of Secondary Education degrees was examined, and their performance on literacy tasks and literacy pedagogy was evaluated. Data reported in the findings were derived from diagnostic testing of the cohort upon entry into a compulsory cross-curriculum literacy unit, and from teaching materials they produced after a semester of training in literacy support strategies. Among the findings was an estimate that 30% of the graduates had “a marginal or limited capacity to teach the literacy of their subject” (2019, p.1).

The original context for the Western Australian ITE Cohort Study was defined by national policy responses to widespread concerns about standards in Australian education. Of specific concern were the declining performance of Australian secondary students, as measured in testing regimes such as PISA (Thomson, de Bortoli & Underwood, 2017) and NAPLAN, the National Assessment Program in Literacy and Numeracy (Australian Curriculum and Reporting Authority, 2018); and the view that entry standards into teacher

education courses were too low to guarantee the high performance expected of entrants to the teaching profession (Louden, 2005; Leigh & Ryan, 2008; Moon, 2014). The resulting policy responses included a set of recommendations flowing from the Commonwealth Teacher Education Ministerial Advisory Group, TEMAG (Teacher Education Ministerial Advisory Group, 2014); the announcement of a compulsory literacy test, the LANTITE, for Initial Teacher Education students (Department of Education and Training, 2016); and the strengthening of the Professional Standards and Curriculum Capability expectations for teaching graduates (Australian Institute for Teaching and School Leadership, 2015; Australian Curriculum and Reporting Authority, 2016). Other initiatives included the formation of a National Education Evidence Base designed to improve understanding of the relation between education policy, expenditure, processes and outcomes (Australian Productivity Commission, 2016).

The national context has not changed significantly since our report of initial findings from the study, though there have been some new developments. The subsequent round of PISA testing has shown continuing cause for concern about the performance of Australian students in key areas such as reading (Thomson, de Bortoli, Underwood & Schmid, 2019). Additionally, data from the LANTITE test taken by teacher education students are now becoming available. While the results are not widely published, results obtained from Freedom of Information requests reportedly show a failure rate of 8.3% for the literacy component in 2019 (Barro, 2020; Zaglas, 2020). While it must be borne in mind that this is a pre-graduation test, and that teacher education students have the prospect of remedial assistance that might enable them to graduate, a figure of 8.3% has naturally raised questions, again, about the quality of entrants to teacher education courses and the professional capabilities of some graduates. That almost 92% of students passed the test should not be forgotten.

In another development, the Department of Education in Western Australia has initiated a new program aimed at addressing literacy standards in secondary schools and improving the ability of secondary teachers to meet the literacy demands of teaching. The *Lifting Literacy* initiative (Department of Education, 2021) duplicates many elements of the training provided to undergraduates represented in the Western Australian ITE Cohort Study. Designed in response to continuing demands from secondary teachers for more support and advice, the *Lifting Literacy* initiative indicates that despite more than thirty years of local research and development in cross-curriculum literacy (including the WA Education Department's own widely praised *First Steps* and *Stepping Out* programs), secondary teachers still feel ill-equipped to tackle literacy in their classrooms. Given the findings of our own research—that a substantial proportion of graduating teachers have only a marginal capacity to teach specialist literacies—the Education Department's announcement of yet another literacy initiative should be unsurprising.

It is to this issue, the ongoing and uphill struggle to help secondary teachers address literacy in their classroom, that our current report is directed. In what is effectively an addendum to the previously announced findings, we offer closer analysis of literacy tasks undertaken by pre-service teachers in the ITE Cohort Study, focussing on vocabulary and word building. We suggest that this further analysis raises doubts as to the efficacy of pre-service literacy training and teacher resourcing, in light of observed limitations in the personal literacy competence of some education students. Since this is an addendum to that earlier report, we are brief in our discussion of the literature and our outline of the methodology.

Our perspective in this study is broadly social-historical. We view literacy as a complex array of socially-embedded reading and writing practices that includes general purpose and domain-specific knowledge, skills and processes. These historically variable

capacities are distributed to the population primarily through schooling and entail cognitive, linguistic, social, and institutional factors. Word knowledge is only one component, but it is considered significant if not foundational. Our purpose here is not to engage with competing definitions of literacy, important though that is; nor is it our intent to adjudicate questions of pedagogy. Our aim is simply to inquire whether teachers who are obliged by the curriculum to cultivate literate competencies in school students have the knowledge and technical competence to do so in the domain of word knowledge.

Literature

Cross-curriculum literacy, whole-of-school literacy, and content-area literacy, as it has been variously named, has been a focus of policy and research for fifty years in Anglophone school jurisdictions, with roots that extend further to at least the 1920s (see, for example, Gray, 1924). The United Kingdom, United States, Canada, New Zealand and Australia have all seen successive waves of interest in the concept, and each of those nations has launched its own development programs at various times (see Ofsted, 2013; National Schools Boards Association, 2006; Ministry of Education Canada, 2011; Ministry of Education New Zealand, 2007, and Department of Education Western Australia, 1996 and 2021, respectively). These programs have generally been designed with two goals in mind: first, to promote awareness of the ways literacy practices are embedded in content disciplines; and second, to equip teachers with the attitudes, skills and resources that will lead to effective teaching of subject-specific literacies.

Such programs are built primarily on findings from psycholinguistic and cognitive branches of education. Research in these fields has documented how subject content is codified by, and transmitted through, language and literacy practices. The work of Herber (1970), Rumelhart (1980), Armbruster and Brown (1984), Morris and Stewart-Dore (1984), Alvermann and Phelps (1989), Vacca and Vacca (1989), Ruddell (2008) and Love (2010) has been significant. Collectively, these researchers have helped explain the language processes involved in recording, translating and expressing subject content; and they have stimulated the development of portable strategies that teachers can adopt and adapt for classroom use. These have included tools such as anticipation guides, vocabulary primers, content organisers, note making formats and writing task templates. While there have been some critiques of the implicit formalism of these instructional tools (for example, Hirsch, 1996 and 2006; Moon, 2012), governments have continued to promote such strategies as the centrepiece of whole-school literacy programs.

More recently there has been a recognition that “disciplinary literacies” (Shanahan & Shanahan, 2008; Moje, 2015) vary considerably, to the extent that good practice in one field (for example, the use of passive voice in science lab reports) may be considered poor practice in another (active voice being preferred in English and History, for example). The work of Shanahan and Shanahan (2008) exemplifies this by contrasting reading practices in History with those in Mathematics: skim-reading is considered appropriate in the former, where the discourse can be verbose and redundant, but not the latter, where the discourse tends to be terse and efficient, and where every detail counts. The realisation that literacy practices are not universally applicable has seen additional research emerge from specialists within learning areas. Examples include the work of Wellington and Osborne (2001), Cohen (2012), Helman et al. (2014) and Lemke (2004) in science education; and Barton et al. (2002), Borasi and Siegel (2000), Grimm (2008), Ricconimi et al. (2015), and Krawitz et al. (2021) in mathematics. Such research has underscored the proposition that subject literacies must be

taught by subject specialists, and that English teachers cannot be expected to instruct students in the nuances of literacy in other disciplines.

While some subject specialists have taken up the call for a cross-curriculum focus on literacy, there has at the same time been growing resistance in some areas, mathematics in particular. Siebert and Draper (2008), for example, have documented the ways in which curriculum literacy researchers have misunderstood or distorted aspects of mathematics in their descriptions of, and prescriptions for, that subject. Likewise, Bean, Bean and Bean (2001) have noted that success in mathematics depends upon mastering forms of reading and writing—involving notation and computation—that have no real equivalents in the discursive practices of other subjects. Such observations, which highlight the distinct characteristics of subject literacies, have the potential to destabilise the field of cross-curriculum literacy, and to undermine concepts such as *general capabilities*. Indeed, they lend support to the idea that cross-curriculum literacy policy might be a kind of wishful thinking by governments looking for simple solutions to a complex problem. While some generalisable, formal skills can efficiently be taught to pre-service teachers by literacy specialists, domain-specific content and skills call for instruction within each curriculum discipline—a more complex undertaking than the “one-size-fits-all” strategy often associated with curriculum literacy classes.

Our own findings further complicate the comfortable assumption that “all teachers” (as the *Australian Curriculum* asserts) can and should be teachers of literacy. Even allowing for the fact that literate practices might vary significantly across disciplines, there is a further stumbling block: that recruits to the teaching profession in any specialist field might lack the necessary personal literacy competence to give instruction in areas such as vocabulary, word building, reading-for-information and expository writing.

The Case of Specialist Vocabulary

In this analysis we focus specifically on vocabulary knowledge and word building skills. Research suggests these are not peripheral competencies but arguably the “core” of literacy and learning (Fisher & Frey, 2014). There is a substantial body of research pointing to the importance of vocabulary in literacy development and to the value of morphological and etymological instruction for reading comprehension and content learning. Vocabulary knowledge—and especially *academic* vocabulary—has been found empirically to predict early school success in areas such as mathematics and social science (Schuth, Kohne & Weinert, 2017); a finding in line with Harmon and Wood (2008), who report that content-area vocabulary is “critical” to conceptual learning. Bowers, Kirby and Deacon (2010), in a systematic review of the literature, established that morphological instruction benefits learners, and especially less able readers. Goodwin and Ahn (2013) in their meta-analysis, found that “children receiving morphological instruction performed significantly better on measures of literacy achievement than comparison groups” (p.257). Likewise, Ford-Connors and Paratore (2015) found that vocabulary connects to comprehension, reading and content learning, and that students benefit measurably from morphological instruction. They also noted that classroom discussion of word structure and meaning is beneficial—implying that teachers need sufficient depth of knowledge about subject terminology to lead such discussions. Similar findings are reported in Nagy (2007), Bertram, Laine and Virkkala (2000), Wagner, Muse and Tannenbaum (2007) and Devonshire and Fluck (2010), and collected in Baumann and Kame’uni (2012).

Our initial analysis of the secondary ITE cohort supported these findings on the link between vocabulary, literacy and content learning. Vocabulary tasks were found to have the highest correlation ($r = .614$) with overall literacy performance across a range of curriculum

literacy tasks. A closer look at vocabulary knowledge and word building skills therefore provides an important window onto questions of personal literacy competence and, by extension, the capacity of ITE graduates to teach discipline literacies in school.

The teaching of specialist terminology involves an array of skills and strategies. These include the ability to define words clearly and accurately; and the ability to teach codebreaking strategies—such as recognising morphological divisions, segmenting words into meaningful units, and applying knowledge of common Greek and Latin roots and affixes (Baumann, Edwards & Boland, 2003; Bear, 2012; Ebbers, 2008; Harmon & Wood, 2008; Brusnighan & Folk, 2012; Moats, 2005). The available research suggests that teachers who make terminology meaningful and accessible in this way enable school students to approach new words with skill and confidence. Recognising and understanding repeated patterns—such as the prefixes and suffixes in words like *isotope*, *isobar*, *isometric*, *isosceles*, or *bauxite*, *graphite*, *haematite*, and *pyrite*—enables school students to leverage existing knowledge when encountering new terms. The cumulative effect of such knowledge is to make the subject discourse seem orderly and graspable, rather than confusing and overwhelming.

Understanding and using specialist vocabulary becomes more challenging for secondary school students as they progress into higher grades. There they confront specialised discipline literacies and a greater number of technical terms (Shanahan & Shanahan, 2008). Knowledge of this specialised vocabulary affects not only the ability to grasp concepts and participate in class; it also affects more formal acquisition of knowledge through reading and comprehension. The presence of unfamiliar and challenging technical vocabulary in textbooks and teaching resources is thus a potential impediment to learning for many students, and one that secondary teachers must address.

In their curriculum literacy studies, ITE students receive input and training in both the foundational understandings (word morphology, roots and etymology) and the pedagogical techniques for teaching such skills. But this training assumes that students have sufficient personal competence on which to build. We present evidence that many graduating secondary teachers lack not only the pre-requisite understanding of morphology—both implicit and explicit—but that they also lack the ability to extend their knowledge and to self-correct by using resources such as dictionaries.

Methodology

Context of the Study

In the Western Australian ITE Cohort study (Moon, Harris & Hays, 2019), the performance of 393 undergraduates in Bachelor of Education courses was examined. The students had completed a one-semester unit on cross-curriculum literacy and strategies, and were all within one semester of completing their final Assistant Teacher Practicum.

The bulk of the data were obtained from performance on assignment tasks related to literacy instruction. The assignment tasks included analysing the readability of a subject textbook; designing reading support materials and notemaking guides; teaching a set of challenging vocabulary items; and creating models and support materials for an expository writing task. These are tasks that a graduating teacher might be expected to carry out in the course of teaching secondary students in Art, Drama, English, Health, Home Economics, Humanities, Mathematics, Science or other subject discipline. Moderated scores on the assignment tasks were analysed, accompanied by examples of errors extracted from the various portfolios of work.

While the initial report provided clear findings about the ability of the ITE students to produce effective learning aids, and to give instruction, the nature of the data also obscured some aspects of personal literacy competence. Because the assignment portfolios were polished final products, the process stages were hidden. The use of spell checkers, thesaurus, formatting tools, tutoring assistance, and other forms of support may have concealed some weaknesses in personal competence. This is a significant issue when assessing the competence of future teachers, because classroom teaching often calls for the *spontaneous* performance of literacy, such as when writing on the board, modelling a written genre, giving a verbal definition of a word to the class, correcting a students' writing in real time, or dealing with administrative matters.

Sample and Data Collection

In this report we present evidence from unrehearsed and unsupported (“raw”) performance on vocabulary tasks. This involved data collected from in-class activities and discussions within the curriculum literacy training unit taken by secondary ITE students. In these vocabulary and word building activities, students applied and shared their prior knowledge without the time to reflect on or polish the outcomes extensively.

The ITE students sampled in this study were fourth-years engaged in a ten-week semester course on curriculum literacy. For the vocabulary and word building topic, students undertook pre-reading of papers by Ebbers (2008) and Harmon and Wood (2008). The readings covered the role of vocabulary in content learning; basic elements of morphology and etymology; and strategies for teaching new words to school students. These concepts were then reviewed and demonstrated in a formal lecture, which included explicit demonstrations showing how to break complex words into parts, how to deduce word meanings from known roots and affixes, and how to find and interpret word-building information in dictionaries and other resources. This was followed by a classroom activity inspired by Ebbers (2008), which involved students breaking words into component parts, linking them to other words, and building up definitions and explanations of their morphology. These are important pre-requisite skills for effective teaching of challenging vocabulary items.

The vocabulary items offered to students ranged from familiar words (*astronaut, quadrilateral*) to more specialised terms (*surrealism, omnivore*). A copy of the word list and worksheet is reproduced in **Appendix 1**. (The worksheet was originally in a larger format, but is reduced here for convenience).

Working in casual, self-selected groupings, or alone if preferred, the ITE students were given time in class to “solve” as many items as possible. This involved first stating the meaning of the word, then breaking it into its parts, and finally linking it to etymologically-related words. Participants were instructed to get as far as possible unaided, and then to use dictionary tools and other resources to complete the task. It was not expected that students would know all of the derivations based on prior knowledge; but it was hypothesised that they should be able to learn and explain the new words and elements, as a teacher might do when preparing to teach key terms to a class.

The findings reported below were obtained from analysis of the completed worksheets and from notes made by the investigator in the course of monitoring the small group activity. Ethics approval was granted for the capture of this data. Students were invited to participate in the research by submitting signed approvals for their class and assignment work to be included in the research, as reported in the full study (Moon, Harris & Hays 2016). For this vocabulary component, students were invited to voluntarily submit their

completed word-building worksheets for analysis. Content emerging from the class and group discussion, and noted by the investigator, was collected as anonymous observational reporting.

The data included here come from two tutorial groups of 28 and 32 students. A total of 51 students voluntarily submitted their worksheets for inclusion (23 in group 1 and 28 in group 2). The total of 51 represents only 13% of the full cohort (n=393); but since we are interested here in analysing the characteristics of the errors, rather than their frequency across the whole cohort, the smaller sample is not considered a major limitation. Interested readers can consult the earlier report for evidence of error frequency across the cohort.

Analysis

Analysis of the data consisted of simple counting and tabulation to generate raw scores and mean scores for the 15-item word-building task. Tables were prepared for initial unaided definitions, unaided word segmentation, and researched definitions. The details and characteristics of errors were analysed by judging the accuracy of answers against the correct definitions, usages and etymologies, as recorded in a standard reference work (*The Concise Oxford English Dictionary, Twelfth Edition*).

Limitations

This report focuses only on types and degrees of error in vocabulary and word-building and is subject to a number of limitations. The 51 subjects are a convenience subset of the full cohort (n=393) and may not be representative of the entire sample, or of beginning teachers generally. Further, the set of words offered to students has not been drawn from a subject-specific “Tier 3” corpus (Beck, McKeown & Omanson, 1987; Beck, McKeown & Kucan, 2013); it consists of generic “Tier 2” vocabulary. Students might be expected to perform differently on words drawn from their specialist learning area—though evidence has been presented previously that most participants struggled even with their specialist vocabulary and could not accurately define core education terms, such as *pedagogy*. Finally, no attempt has been made here to correlate these results with course entry scores, with overall academic standing, or with socioeconomic data, which might provide further insight into the findings. (Some of that data, including number of unit attempts, has been reported in the original WA ITE Cohort Study.)

Findings

Quantitative

Of the 51 students who participated in the activity, none was able to correctly define from prior knowledge all of the words on the list. The highest score was 10 correct definitions, out of a possible 15, obtained by two students. The lowest score was 1 correct definition, obtained by four students. The mean number of correct definitions was 4.4. These results are presented in **Table 1**. Results for individual word items varied considerably. The words *astronaut* and *quadrilateral* were correctly defined by more than 70% of students. *Exfoliation* and *orthographic* were equal in receiving no correct responses.

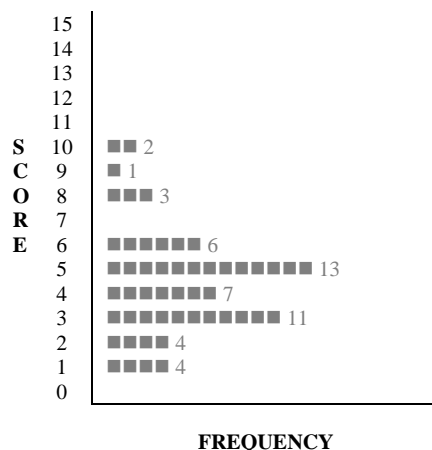


Table 1. Results for Correctly Defining 15 Tier 2 Words Unaided.

Participant n = 51. Mean score = 4.4

The task of segmenting words into morphological units (for example *astro/naut*) yielded a higher mean of 9.0, indicating that most students could recognise where the divisions in words occurred. Three students scored 14 correct responses, while a single student scored 1. These results are presented in **Table 2**. Despite the overall higher mean, the scores ranged widely. This reflected uncertainty about root words and confusion between morphological units of meaning and phonetic syllables. A number of students mistakenly broke words down into syllables (*as/tro/naut*), while others under- or overestimated the number of segments in words (for example, *om/nis/cient* rather than *omni/scient*). Some students left a number of words unsegmented.

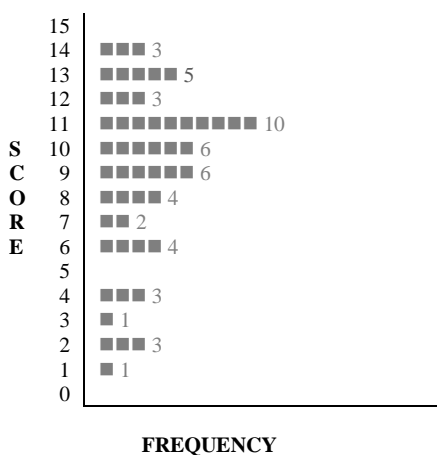


Table 2. Results for Correctly Segmenting 15 Tier 2 Words into Roots and Affixes Unaided.

Participant n = 51. Mean score = 9.0

In the third stage of the activity, students were able to consult dictionaries or online sources to refine their definitions and explanations. Three criteria were applied to determine a correct answer: a clear definition; correct etymology; and links to words with related etymologies. Thus “*astronaut – a space traveller, from aster/astron (star) and nautes (sailor)*” was considered a correct definition if accompanied by links such as *astronomy*, *nautical*, and *cosmonaut*. The definitions “*sailor in a space ship*” or “*sailor among the stars*” were also accepted, as they construed the meaning correctly and conveyed the etymology. Incorrect answers were those that distorted or confused the meaning, such as “*traveller in*

empty space.” Linked words that were synonyms but not cognates (such as *shuttle pilot*) were also marked incorrect, even if the initial definition was otherwise sound.

Table 3 records the results for the third phase. Only 42 of the 51 students completed the activity to this final stage, so the results are not directly comparable with those for definition and segmentation. Nevertheless the near-bimodal distribution and mean of only 6.6 indicate that access to the dictionary did not result in a dramatic improvement in outcomes for all participants. While many students clarified their definitions, a large number distorted or misinterpreted the dictionary information, and many made erroneous linkages that did not reinforce the morphemic patterns that would assist codebreaking of related words in the future.

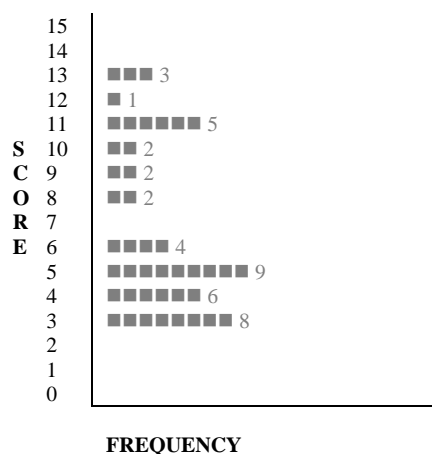


Table 3. Results for Correctly Defining 15 Tier 2 Words with Reference Aids.
Participant n = 42. Mean score = 6.6

The nature of such errors, and their implications, becomes clearer only through a study of the descriptive findings, which document the content of conversations, written responses and questions that accompanied the task. These data reveal some of the thinking processes involved. They also tell us something about the participants’ ability to use resources such as dictionaries.

Descriptive

Two general findings emerge from the descriptive data. The first of these is that many initial guesses for word meanings and etymologies were not merely wrong but wildly—and in some cases irrationally—wrong. The second general finding is that even with access to dictionaries and other tools, a substantial number of students could not arrive at correct definitions and breakdowns. This is because they failed to understand the conventional formats and nomenclature used in dictionaries. To illustrate these points we present descriptive findings for a selection of items from the word list.

‘Astronaut’

The root *aster* (Greek *astron*) had been demonstrated in the lecture, in relation to the word *astronomy*. It was there defined correctly as “star.” Despite this, most students translated *astro* as “space” in the word-building activity. As a verbal hint for some groups who were “stuck” defining the root words, the lecturer suggested there might be a clue in the word

“asterisk” (literally, a little star). This only created confusion with *Asterix* (the comic book series by Goscinny and Uderzo), revealing that some students routinely mispronounce the word. The second component of the word (~*naut*) was a further source of difficulty. A popular guess in one tutorial class was that “naught” means nothing – the “nothingness of space” as one student phrased it. But the resulting definition “empty space” makes no sense in relation to the word *astronaut*, which is the name of a job or professional role. Upon researching the word, most students were able to use the Greek root *nautes* to form the literal translation “sailor in a space ship” or “sailor among the stars.” None of the students was able to spontaneously connect the word *astronaut* to the word *nautical*, however, in Column 3 on the task sheet. (*Nautes* is the morphological root for sailors of all kinds—*astronaut*, *aquanaut*, *cosmonaut*—based on the Greek word for a sailing ship, *naus*.) This was one of the easier words on the list, but in their initial attempt many students could solve only half of the word; and some proposed solutions that did not make logical sense.

‘Quadrilateral’

This was one of few words on the list that most students could correctly define unaided. They recognised *quad-* as four, and recalled *quadrilateral* as a word from geometry. Most could not go further, however, to explain ~*lateral* as “side,” derived from the Latin *lateris*. This is despite the status of “lateral” as a modern English adjective. Most could not spontaneously suggest *equilateral* or *unilateral* as linked words, focussing instead on *quad*: “quadriceps” and “quad-bike” were common linkages. This suggests that students recognised “quad” as a number prefix. Recognition of other number prefixes was limited, however. In discussion, students were able to identify and explain *bi* and *tri*; but there was confusion surrounding *uni* and any Greek or Latin number prefixes above four, such as *quin/penta*, *sexa/hex*, *septa/hepta*, *novi/ennea*, and *deka*.

‘Geography’

Guesses for *geo-* included “land,” “place,” “map” and “rock.” A small number of students guessed “world” or “earth.” The suffix ~*graphy* eluded most students, despite the words *biography* and *photography* having been demonstrated in the lecture. Even after researching online, many students remained confused. Dictionaries note that ~*graphy* is “the combining form” of the Greek *graphē* (writing). Some students read the phrase “combining form” as a definition, rather than a pointer to the way *graphē* combines with other words. They concluded that *geography* means “combining places” or “combining the form of the land.” This basic error revealed that the students were unfamiliar with dictionaries and dictionary shorthand and so could not use those resources to arrive at the correct answer. This error also illustrates the tendency among students to back-form etymologies from an often inaccurate understanding of the word in use (*geography* as a study that “combines places”).

‘Computer’

This was one of the more challenging items. No student could guess correctly the morphology and derivation of *computer* (which is based on the Latin *putare*, to calculate). This was despite the prefix *com-* (with) having been demonstrated in the lecture, through an analysis of the words *companion* and *comprehend*. A popular guess during the discussion phase was that *com* stood for “dot com” (*.com*) meaning the internet; and that “puter” meant

“to put.” This resulted in the guesses “to put on the internet” or “to put online.” A moment’s thought should have revealed that for this explanation to be true, the word *computer* would have to be of more recent origin than the internet. This erroneous guess also revealed that students did not know that *.com* at the end of an online URL stands for “commercial.” Their illogical guess at the derivation indicates both a lack of general knowledge and a tolerance for nonsensical explanations. These are points we take up in the Discussion.

‘Unicorn’

Students were evenly divided in their explanations on whether *uni-* meant “one” or “all.” They were presumably confused by the all-encompassing connotations of words like *universe*. Those who guessed “all” could make no headway on why a unicorn is called a unicorn. One student facetiously suggested that since unicorns are fanciful, the word meant “all corn” (implying they were “corny,” or silly). Most of those who guessed that *uni-* means “one” were able to then guess that unicorn meant “one horn”; but they were unable to recognise the Latin root *cornu*, which is the basis for many kinds of horn, such as *cornet*, *cornetto* (an ice-cream cone dessert), and *cornucopia* (the horn of plenty). Consequently, most students could not link *unicorn* to any other words derived from *cornu*.

‘Omniscient’

This word was recognised by most students, but the most frequent definition for it was “powerful” (suggesting confusion with *omnipotent*) rather than “all-knowing.” *Omni* was correctly identified as a morpheme, though it was frequently decoded as “one” (see the related confusion over *uni-*, above) or “total,” rather than “all.” The students did not seem to know the Latin root *scientia*; nor could they spontaneously connect *omniscient* to other common words that share the same root, such as *science* and *conscience*. Online research did lead eventually to correct explanations by most students; however, some arrived at definitions such as “all of science,” indicating an inability to integrate correctly the various items of information provided in the dictionary.

‘Ambidextrous’

Many students did not know the meaning of this word. Their guesses as to its form and derivation were therefore limited. Some confused *ambi-* with *amphi-*, and were initially misled by thinking of *amphibians*. After being verbally prompted to focus on the second morpheme *dextrous*, some then pursued a second dead-end, guessing that it was related to *dextrose*, a sugar. A further hint, suggesting a link to the Latin *dexter*, triggered recall of television series by that name. The origin and meaning of *dexter* and *sinister* were unknown to students. However, most were able to offer a correct definition after consulting a dictionary.

‘Oxymoron’

The term *oxymoron* was not known to students, and so once again their guesses were hindered by a lack of familiarity with the usage. Some students guessed that it was a pairing of “oxygen” and “moron”; and students in one group speculated that it was the origin of the

phrase “oxygen thief,” referring to a foolish or abhorrent person. This was an example of students erroneously equating a prefix (*oxy-*) with a whole word (*oxygen*), in spite of the fact that the prefix appears *within* the whole word. They were completely unfamiliar with the root *oxus*, and its use in English words signalling sharpness or acidity. The derivation of *oxymoron* as “sharply or pointedly foolish and contradictory” (based on *oxus* + *moros*) eluded them. Many students remained confused even after dictionary work and a discussion of the etymology.

In addition to the list words, two extra challenges were offered to students in the activity. These were to find morphological linkages between *omniscient* and *voracious* (the missing link is *omnivore*), and between *orthographic* and *mastodon* (the link is orthodontist, or orthodontic). None of the participants completed the challenge tasks.

Discussion

The findings presented here not only add weight to prior observations that many secondary ITE students have limited knowledge of word building and word roots (Moon 2014; Moon, Harris & Hays, 2019); they also reveal an underlying confusion about *how* words mean, and an inability to self-correct by consulting resources such as a dictionary. It is not merely the case that students were ignorant of specific words and roots, but that some participants lacked an expectation of order and sense in words, and lacked experience in making connections between words. These gaps and confusions represent deficiencies in *content* and *schema*. We address them in turn.

The failure to recognise the root *scientia* (from *scire*), and the inability to interpret it as “knowing” or even “science,” could be described as a gap in content knowledge. It is arguably a concerning gap in a group of pre-service teachers with twelve years of secondary school and three years of tertiary education behind them. Many important words are based on that particular root: *science*, *conscience*, *prescience*, *consciousness*, and more. A student who had one such gap in knowledge, but who otherwise possessed a well developed schema for word morphology and etymology, could fill the gap by learning the new root and a number of its cognates. Few among the sampled cohort had only one gap, however. As we have seen, common derivations and affixes such as *bio*, *omni*, *uni*, *geo*, *grapho* and *cyto* were also unknown or unclear to many participants. This suggests that content gaps in themselves are a significant problem and likely to compromise the ability of some graduates to teach new vocabulary in school settings.

Of greater concern, however, are the evident weaknesses in *schema*, defined by Anderson as a “knowledge structure” that organises the relationships among components (Anderson, 1978; also Rumelhart, 1980). It is clear from the descriptive data, and from students’ own comments during class discussion, that many have a weak or nonexistent knowledge structure related to word meaning, morphology and etymology. This was evident in the confusing guesses for words such as *computer* and *oxymoron*, where errors of logic and chronology demonstrated weak schematisation. Proposing that the word “computer” refers to the internet; or that “oxy” in the word “oxygen” means “oxygen” (substituting part for whole) indicates circular reasoning, a confusion of cause and effect, and a willingness to accept non sequitur connections. Students who make many such errors evidently lack a logical framework for understanding how words are formed and evolve—and how borrowings from Greek, Latin and French have influenced the English language.

For these students, improvement will not be a simple matter of adding to their schema by filling gaps in content knowledge; they are faced with the task of building a new schema. Some of the low-scoring participants swore they had never before been given any systematic

instruction in word building. Demonstrations of etymologies and of linkages between words struck them as a revelation. One Design and Technology major declared in class, approvingly: “This is completely blowing my mind!” Students were not resistant to the content, and many were excited by it; they found the study of words both intrinsically interesting and a boon to their understanding of content. But they were ill-equipped to capitalise on the new information. Their attempts to predict, or even to research, word meanings only led to further confusion. The example of *geography* illustrates the depth of this problem. A number of students were unable to clarify the meaning and structure of the word even after consulting a dictionary, because they did not understand the format and nomenclature used in dictionaries to clarify word meanings and origins. These students construed the explanation of morphology (“x is the combining form of the root word y”) as part of the definition they were seeking. Thus, they defined *geography* as a subject about “combining places” or “combining landforms” or “combined writing about earth.” Lacking a schema for the underlying structure of word form and meanings, they were unable to self-correct even when provided with relevant resources. Many of the responses showed a degree of ingenuity and wit, and some might be considered playful—though there was no indication that participants were not taking the task seriously. However, such ingenuity could not compensate for the fact that even the unequivocally sincere definitions were frequently wrong and potentially misleading to school students.

Against these observations, it might be objected that the words given to students on the vocabulary list were rare, complex, or decontextualised. Against such objections we observe that secondary school teachers in specialist subjects must deal with even more complex vocabularies in their classroom content, textbooks and resources. The following are just a few examples of terms found in a selection of secondary school disciplines.

homoeostasis, subcutaneous, adenosine triphosphate (Physical Education)

chiaroscuro, palimpsest, neoclassicism, renaissance (Visual Art)

mitochondrion, erythrocyte, gluconeogenesis, ribonucleic acid (Biology)

accelerando, diminuendo, capriccioso, pianoforte, chromatic scale (Music)

malleable, ductility, oxyacetylene (Technology, Materials Science)

hexadecimal, algorithm, heuristic, trigonometry (Mathematics and Computing)

proscenium, dramaturge, amphitheatre, protagonist, antagonist (Drama/Theatre Studies)

These specialised terms, we suggest, are more challenging than many on the word list. Further, a number of simpler words on the activity list (such as *astronaut* and *unicorn*) proved to be just as challenging for some students as the rarer and more complex items. That the words were decontextualised has been noted, but since the task was designed to analyse general-purpose skills, such as distinguishing word roots from affixes, the issue of context is not especially relevant.

Given the established connections between vocabulary, literacy and comprehension cited above (Baumann, Edwards & Boland, 2003; Brusnighan & Folk, 2012; Cohen, 2012; Ebbers, 2008; Fisher & Frey, 2014; Grimm, 2008; Harmon & Wood, 2008; Riccomini et al., 2015) and the expectation that subject teachers will teach explicitly the literacies of their learning area (Australian Curriculum and Reporting Authority, 2015; Australian Institute for Teaching and School Leadership, 2015), these findings highlight a potential impasse in plans to raise the academic performance of Australian students. Australian education faces a chicken-and-egg paradox: raising standards in schools requires teachers with well developed literacy schemata and knowledge; but teachers are recruited out of a school system that is evidently failing to provide that knowledge for a substantial segment of the student cohort. We suggest that this intergenerational cycle is part of the reason why successive literacy

initiatives have failed to effect a permanent improvement in school achievement. How, then, did we arrive at this state of affairs; and what might be done to resolve the impasse?

Morphology and Etymology in School English

Part of the explanation for the observed weakness in content knowledge and schema related to word meanings and morphology is that such content was de-emphasised in Australian secondary schooling during the latter half of the twentieth century. In earlier times, the formal study of English grammar, vocabulary and etymology had been a centrepiece of compulsory English studies. Additionally, in Western Australia, languages such as Greek and Latin were offered as discrete courses in many schools through to the 1950s, at both Junior Certificate and Leaving Certificate levels (Education Dept of Western Australia, 1955). The debt owed by English to classical sources and language was acknowledged explicitly across the curriculum; and attention to language origins, word forms and meanings was deeply embedded in the teaching and examination of English. Questions on early English examination papers speak for themselves:

Show how English has added to its resources of expression during the last thousand years by the extended use of auxiliaries in the conjugation of the verb. Say what you know about the derivation of each of the following words: bismuth, piano, skipper, gong, tobacco, assault, ox, photograph, quartz, veranda.
(Education Department of WA, 1914)

Such detailed and decontextualised study waned in the 1950s in favour of examining words in context—especially literary contexts. But attention to word forms and origins remained a feature in textbooks and teaching materials into the 1960s. The WA Education Department's own publication, *Word usage in the secondary school* (1962), foregrounded Latin and Greek roots and affixes in its approach to vocabulary and usage. Nationally, the popular textbook *Mastering English* (Wheeler & Walsh, 1969) continued that tradition, teaching Latin roots, prefixes and suffixes in each of its 30 units of work. By the 1970s, however, even textbooks offering traditional approaches to grammar, such as the *Language* series (Sadler, Haylar & Powell, 1978), had markedly reduced such content, spotlighting Latin roots and basic morphology only in isolated units and in chapters dealing with the history of the English language.

By the last decades of the twentieth century, the systematic teaching of word origins, Latin roots, prefixes and suffixes had fallen out of favour. A slew of government reports—*The Bullock Report* (Dept of Education and Science, 1975), *The Kingman Report* (Dept of Education and Science, 1988) and *The Cox Report* (Dept of Education and Science, 1989) in the UK; and later *The Martin Report* (Martin, 1980) in Western Australia—highlighted the need for greater attention to language, and greater knowledge about language on the part of English teachers. But their recommendations were undercut by an insistence on concepts such as “language-in-use,” “whole language,” “real purposes” and “authentic tasks.” These phrases were code for rejecting explicit instruction in language, in favour of expressive, reflective and communicative activities. Such activities emphasised experiences, processes, issues and values over the direct teaching of vocabulary, grammar or style. The rise of so-called ‘language-experience’ methods was arguably a vital development with many benefits; but it came at the cost of systematic instruction in word building and etymology. A bias against systematic instruction in English remains entrenched in the modern era, partly because new teachers lack the foundational knowledge for teaching such content.

Explicit knowledge of word meaning, morphology and etymology—and of specific Greek and Latin roots—remains relevant, however. The English language is an amalgam of

Anglo-Saxon, Danish, French and Latin, with substantial borrowings from Greek, Arabic, and numerous other sources. This reality not only complicates English spelling, but makes an understanding of word origins and morphology indispensable to readers and writers seeking to extend their literacy and their rhetorical competence (Moats, 2005; Nagy, 2007; Ebbers, 2008; Harmon & Wood 2008; Wagner, Muse & Tannenbaum, 2007; Bear, 2012). Such knowledge is especially useful in decoding the technical vocabularies one encounters in advanced study of the arts, sciences and humanities. The post-enlightenment convention of using Greek and Latin to standardise the scientific names of objects and processes means that modern readers are confronted with a host of foreign terms that are a potential barrier to reading and understanding. Readers who can recognise Greek and Latin roots and affixes have a clear advantage over those for whom such words are an impenetrable puzzle that must be mastered by rote rather than solved by analysis. An understanding of common prefixes (*ambi-*, *hypo-*, *iso-*, *peri-*, *retro-*, for example), in combination with familiar roots (*dexter*, *derma*, *skopeo*, *topos*, for instance) enables a reader to see the structure of meaning within words such as *ambidextrous*, *hypodermic*, *isotope* and *periscope*. Readers who understand these connections can also trace the links between words with similar morphology, enriching not only their vocabulary knowledge and reading ability but also their grasp of subject content.

While the new *Australian Curriculum: English* (Australian Curriculum and Reporting Authority, 2015) now clearly addresses the formation, history and evolution of English under its “Language” strand, it is not clear that all school students are receiving deep and systematic instruction in word origins and morphology, as was once the case. Attention to these topics appears sporadic and incidental, if it is given at all. Western Australia’s ATAR (Tertiary Admission) English examinations do not test linguistic knowledge explicitly, having abandoned direct testing of reading and vocabulary in 1998; and large-scale tests such as NAPLAN focus on functional literacy rather than a declarative knowledge of subjects such as etymology and grammar. The presumption is that such knowledge will be evident (or not) in the functional performance of students and so does not need to be tested in isolation. One consequence of this approach is that factors which contribute to functional competence, but which are not rendered visible in the test, become de-emphasised in classroom teaching. That is not say more testing is the answer. But a renewed emphasis on vocabulary and word building seems warranted.

Implications

In the results of the WA ITE Cohort study we see the consequence of diminished attention to vocabulary and word building in secondary schooling. For a proportion of ITE undergraduates, secondary school has failed to develop their word-knowledge schema and so has left them ill-equipped for autodidactic correction and poorly prepared to explain vocabulary to their future students. While pre-service curriculum literacy training and school resourcing efforts offer teachers some training in pedagogical routines and strategies, they do not address fundamental gaps in content and schema of the kind documented here. Countries like Australia thus face an intractable obstacle in their desire to raise school standards: it is the paradox of which must come first, better teaching, or better school standards. Given that all teachers begin as school students, this is a knotty problem indeed. We suggest a simultaneous response within both the school sector and the tertiary training sector is needed, aimed entrenching deeper knowledge of word forms and origins.

Conclusion

Mastery of a specialised learning area entails—among other things—mastery of its terminology. That mastery is aided by a deep understanding of the connections between word formation, meaning and subject content. Subject teachers must possess and be able to foster such understanding in the classroom. Here we have documented gaps in word knowledge and weaknesses in underlying schema among 51 ITE students drawn from a larger cohort study. We have noted that their shortcomings constitute an obstacle to effective teaching of subject literacies and subject content in secondary schools—an obstacle that existing training programs and resources are not equipped to address. We suggest that longer term solutions are needed, involving coordinated action at secondary and tertiary levels. A more explicit approach to the teaching of vocabulary and word-building knowledge may be part of the solution.

Declaration

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Appendix 1. Vocabulary Task Worksheet

After Ebbers (2008). *Linking the Language*.

For each word on the list, do the following.

In column 2, give your best definition of the word without consulting any resources. Then break the word into structural units of meaning. Give the meaning of each part if you know it.

In column 3, link the word to any others you know that share the same structural units. Make links to more than one part if you can.

In column 4, add to or correct your guess after consulting a dictionary or other helpful source.

1. Word	2. Meaning and etymology	3. Linking words	4. Notes and explanations
Example: isobar	line on a weather map showing equal air pressures iso = same, equal, baros = weight, pressure	isometric , isotonic , isotope topographic , topical barometer , thermometer	isotope = iso (same) + topos (place) an element “in the same place” as another on the periodic table metron = measure, (e.g. thermometer, metric, kilometre)
astronaut geography omniscient meteorology unicorn ambidextrous equilateral hypodermic orthography exfoliation submarine bionic surrealism computer cytoplasm			

Challenges: Can you make a link from *omniscient* to *voracious* in two steps? From *orthographic* to *mastodon* in two steps?