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Enhancing Phonological Awareness and Orthographic Knowledge of Preservice Teachers: An Intervention through Online Coursework

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Abstract: The teaching of reading is a core priority across the education sector. In an attempt to better prepare our next generation of professional teachers of reading, academic staff at an Australian university implemented coursework changes that were designed to enhance the phonological awareness and orthographic knowledge of first-year preservice teacher education students. All students were asked to complete written surveys measuring phonological awareness and orthographic knowledge during class-time at the start and end of their first semester of study. During the semester, students were expected to complete two online modules on phonological awareness and orthographic conventions and pass an online quiz (worth 10% of their grade) as part of their course on the Teaching of Reading and Writing. Education students' performance in phonological awareness and orthographic knowledge improved significantly over the course of the semester. However, a significant percentage of students failed to achieve mastery level in phoneme-level awareness. Implications and future directions for current higher education practices are presented.

Keywords

Teacher education; speech pathology; reading instruction; phonological awareness; orthographic knowledge

Introduction

The emphasis in education policy on the quality teaching of reading in Australian classrooms (Australian Government, 2005; 2015) has recently escalated in response to the alarmingly low literacy performance of our Australian primary school students compared to international benchmarks (Mullis, Martin, Foy, & Drucker, 2012). Teaching reading is complex, however there is general consensus that the process of reading involves five key components: phoneme awareness, phonics, word study and spelling, reading fluency, vocabulary, and text comprehension (National Reading Panel, 2000). Recent debates have focused on including a sixth key element of oral language (Konza, 2014). The importance of the broader social and cultural aspects influencing the process of learning to read has also been noted (Adoniou, 2017; Barton & McKay, 2016). We advocate an approach to the teaching of reading that takes into account a range of perspectives found in the research literature, including from psychological and cognitive views as well as socio-cultural or anthropological standpoints.

Even though a holistic approach to the teaching of reading is advocated by many educators as important for young children, we acknowledge the importance of teaching the skills that are considered key ingredients for early reading success: phonological awareness and orthographic knowledge (Cunningham, Perry, Stanovich, & Share, 2002; Gillon, 2004; Moats, 2000; Scull & Raban, 2016). This paper shares results from a study at an Australian university where first year preservice teachers participated in coursework that underwent changes in order to enhance their phonological awareness and orthographic knowledge skills.

Brief Review of the Literature

The Teaching of Reading

The teaching of reading has been noted to be of national significance in Australia (Australian Government, 2005; 2015). Indeed a recent policy document, the Teacher Education Ministerial Advisory Group (TEMAG) report, has called for “action to improve the quality of teachers in Australian schools must begin when they are first prepared for the profession” (Australian Government, 2015, p. viii) with the teaching of reading being a key priority area.

National and international evidence shows that teachers may not receive sufficient knowledge and training in teaching of reading, limiting their ability to effectively teach some of the fundamental early literacy skills in their classrooms (e.g., Brady et al., 2009; Mahar & Richdale, 2008; Stark, Snow, Eadie, & Goldfeld, 2016; Tetley & Jones, 2014). Not surprisingly perhaps, research has shown that preservice teacher education students show relatively low levels of performance in phonological awareness and orthographic knowledge (Fielding-Barnsley, 2010; Purvis, McNeill, & Everatt, 2016; Washburn, Binks-Cantrell, Joshi, Martin-Chang, & Arrow, 2016; Washburn, Joshi, & Binks-Cantrell, 2011).

To address this issue, there is a clear need for teacher education programs to provide their students with further knowledge in phonological awareness and orthographic knowledge (e.g., Carroll, Gillon, & McNeill, 2012; Coltheart & Prior, 2006). Without explicit knowledge about the structure of spoken language or the characteristics of the English writing system, it is difficult for teachers to teach reading effectively (Moats, 1994; Munro, 1999; Spear-Swerling & Brucker, 2004; Tetley & Jones, 2014).

For the purpose of this paper we define phonological awareness as the conscious awareness of the sound structure of spoken language (Gillon, 2004). Phonological awareness includes syllable awareness (a/ni/mal = 3 syllables), onset-rime awareness (onset in *rust* is /r/ rime is *ust*), and phoneme awareness (r/u/s/t is 4 phonemes). Orthographic knowledge refers to the information that is stored in memory that tells us how to represent spoken language in written form (Apel, 2011). For example knit is represented in writing with a /kn/, even though there are three phonemes /n/ /i/ and /t/. Although phonological awareness and orthographic knowledge may develop independently, there are clear orthographic influences on phonological awareness tasks (Castles, Holmes, Neath, & Kinoshita, 2003), underlining the importance of targeting both.

We also acknowledge that supporting children in reading in schools involves a range of stakeholders including school administration, teaching staff and specialist staff including learning support teachers and speech pathologists (Serry et al., 2016). Teacher knowledge, however, is critical for the teaching of reading, including for those children who struggle with reading (Washburn et al., 2011). As such, this research study aimed to evaluate whether a targeted online approach to teaching phonological awareness and orthographic knowledge for preservice teachers was successful in improving their skills in these areas during their first year of study.

Online Learning as an Effective Strategy

Without doubt, online components of study in higher education institutions are becoming more prevalent as a platform for students' learning (Anderson & Elloumi, 2004). The decision to do so is often driven by a systemic-wide need to deliver cost- and time-effective programs and courses (Garrison & Kanuka, 2004). There is also a strong belief that contemporary students are tech-savvy who prefer to engage with technology throughout their learning journey (Kennedy et al., 2008), despite Diaz' (2002) work reporting on an increased dropout rate and attrition in regard to online and distance courses. Bennett and Maton (2010) however, indicate such claims are based on popularity rather than evidence.

Regardless of people's perspectives on the efficiencies of online learning, it is important that such aspects of study programs are carefully developed to ensure student engagement and relevance (Pelley, 2014). Prince (2004) for example outlines a range of strategies to increase active learning for students online, including: student activity in lectures and self-paced modules, promoting student engagement, collaborative and cooperative learning, and problem-based learning.

Further, instant communication and feedback allows students to feel as though they are achieving success throughout a course of study (Lizzio & Wilson, 2008). Many have therefore noted that assessment such as online quizzes which are not high-stakes and worth a small amount of overall marks, can engage students and improve their achievements overall (Hoskins & van Hooff, 2005). For example, Mupinga, Nora and Yaw (2006) recommended "frequent quizzes for review that can easily be assessed by students for regular feedback, and letting students provide feedback to each other on small assignments" (p. 188). For these reasons we decided to implement interactive online modules and an associated quiz to improve students' phonological awareness and orthographic knowledge.

Background to this Study

Despite its importance, there is relatively little research examining the effectiveness of interventions to improve preservice teachers' knowledge of important constructs for early reading (Clark, Helfrich, & Hatch, 2017; Purvis et al., 2016; Spear-Swerling & Brucker, 2004; Stainthorp, 2004). Some research shows that more time should be spent in Initial Teacher education (ITE) programs on preparing preservice teachers how to teach reading (Australian Government, 2015; Louden et al., 2000), but this does not necessarily translate to better outcomes (Clark et al., 2017). One recent study that aimed to better support preservice teachers' language structure knowledge during their university coursework was a New Zealand study by Purvis et al. (2016). The study investigated how seven hours of coursework targeting direct, explicit teaching of phonological awareness, morphological awareness and orthographic knowledge impacted on first year preservice teachers' skills in these areas. On the whole, the study found that an increase of targeted teaching and learning about these topics improved the preservice teachers' performance on tasks measuring phoneme, morpheme, and orthographic knowledge (with large effect sizes). Based on their results, Purvis et al. (2016) recommended that pre-service teacher education courses should include explicit teaching of these skills in order to ensure positive impacts on students' learning in the classroom context.

The Current Study

The study by Purvis and colleagues (2016) provided the impetus for the current authors to conduct a pilot study in which we tracked the phonological awareness skills of Australian Bachelor of Primary Education (“education”) and graduate-entry Master of Speech Pathology (“speech pathology”) students in response to their regular university courses during the first semester of study (Westerveld & Barton, 2016). The results from this pilot study showed that regular course work (i.e., one week spent on the topic within a 12 week course) was not sufficient in enhancing phoneme awareness in first year education students (Westerveld & Barton, 2016).

We therefore decided to introduce two online coursework modules and associated assessment tasks (in addition to their regular course work), covering the topics of phonological awareness and orthographic knowledge. The development of these modules was influenced by the research-based evidence related to early reading development (Moats, 2000; 2014). The modules were designed with three ‘critical elements’ in mind, as outlined by Herrington et al. (2001):

- 1) quality of pedagogy, including the use of authentic tasks;
- 2) quality of resources, making sure the resources are organised clearly and that the students have access to the resources at any time during the semester;
- 3) delivery strategies, such as using the students’ existing online platform (p. 266).

To encourage the students to engage in these online modules and in line with assessment-driven learning (Biggs & Tang, 2011), the students were required to complete a quiz following the completion of the modules which counted towards their final course grade. We monitored student engagement with the quiz, including the number of attempts, as well as their performance (number of questions correct). We also evaluated the impact of this change in content delivery on students’ phonological awareness and orthographic knowledge using a pre- and post-survey. The following question was asked: Does the introduction of two online course modules, with associated assessment tasks, improve preservice teacher education students’ performance in phonological awareness and orthographic knowledge?

Method

Participants

Ethics permission was obtained from the relevant university human ethics committee. All students enrolled in the first year course on early years literacy which counted towards a Bachelor of Primary Education were invited to complete a survey in-class in the first week of semester and again at the end of the semester (week 12). At the start of the semester, a total of 294 Education students (out of 456 enrolments) completed the survey; at the end of the semester, 189 students (79.4% of enrolled students) completed the survey. The mean age of the education students was 21.7 years (SD = 6.5, range 17 – 51 years).

Survey

The survey consisted of questions testing phonological awareness, morphological awareness, and orthographic knowledge and took 7 – 10 minutes to complete. The questions were sourced from Carroll, Gillon, and McNeill (2012) which were adapted from the

Teachers' Test of Phonological Awareness (Love & Reilly, 1995). They were also the same ones used in the authors' pilot study (Westerveld & Barton, 2016) to allow for comparison across the 2015 and 2014 cohorts. For the current study, we analysed students' responses to five questions testing phonological awareness at syllable, onset-rime, and individual phoneme levels, and one question (4 items) tapping into orthographic knowledge (identifying words that start with the same sound, e.g., *knave* and *pneumonia*). For a full copy of the survey refer to Carroll et al. (2012). Similar to the previous year, the survey was handed out at the beginning of the tutorial and no further instructions were provided. The same survey was used at the start and at the end of the semester.

Regular Class Instruction

Similar to the previous year (see Westerveld & Barton, 2016), education students spent one two-hour tutorial out of 12 focusing on phonics (Hill, 2012; Chapter 10) and one two-hour tutorial on phonological awareness (Hill, 2012; Chapter 6) and teaching phonics (Hill, 2012; Chapter 10) during their first year Teaching of Reading and Writing course. As in previous years, this course included a range of other tutorials, face-to-face lectures, and assessment items that were related to the teaching of reading and writing as well as children's literature.

Online Modules

Two new online modules, each taking about one hour to complete, were developed and introduced. Students were expected to complete the modules prior to week 12 before attempting the online quiz (described below). The first online module focused on phonological awareness and phonics. This module was developed and informed by evidence-based research on these topics (Hill, 2012; Moats, 2000; Yopp & Yopp, 2009). Upon completion of this module, students were expected to be able to: a) define phonological awareness, phoneme awareness, and phonics; b) understand that language is made up of words, syllables, and phonemes; and c) understand the relationship between letters and sounds.

The second online module addressed orthographic awareness. Upon completion students were expected to be able to: a) define orthography and orthographic knowledge; b) understand that words have particular origins (e.g., Latin); c) know that letters can represent particular sounds or sound-combinations; and d) know that sounds can be represented by different letter combinations.

Quiz

Prior to completing the quiz, students were provided with a sheet of practice questions and answers. Towards the end of the semester, students were asked to complete an online quiz (20 questions) to test their phonological awareness (10 questions) and orthographic knowledge (10 questions) following completion of the online modules. Students had to achieve 18 out of 20 questions correct to pass the quiz and obtain 9-10% towards their overall course grade. Students could attempt the quiz as many times as they wanted and were allowed to refer to their learning materials, although there was a time limit of 30 minutes for completing each quiz. Following completion of the quiz, students were able to obtain an automatic itemised overview of their performance, including the correct answer for each

question. Student performance on each attempt was tracked, but only their final attempt was recorded for grading purposes. The quiz was compiled by a trained research assistant, using existing resources (e.g., Moats, 2000) and contained a question bank of 50 questions identifying a (first, second or final) sound in a word, 110 questions requiring the counting of phonemes in a word, and 75 questions related to orthography. The questions were randomised out of these three question banks so each student would have received different questions to answer with each attempt. The appendix provides examples of quiz questions.

Results

Data Analysis

Student responses from paper copies of the survey were entered into Survey Monkey® by independent research assistants. Responses were downloaded from Survey Monkey into Excel and exported into SPSS. Descriptive statistics were used to describe student performance on the survey questions at the start and end of the semester. Independent samples t-tests were used to determine if the students made significant progress in phonological awareness and orthographic knowledge over the course of the semester. To monitor student engagement with the online tasks, quiz data were downloaded from the online learning platform Blackboard, which included the number of attempts by student as well as the performance in percentage of questions correct for each attempt.

Student Performance on the Survey Questions

Table 1 shows the results at the start and end of the semester. As shown in Table 1, there was a wide range in performance on all questions, except for syllable awareness. The students made significant improvements on most questions, except for syllable awareness which showed a ceiling effect at the start of the semester. We also wanted to determine the percentage of students who showed mastery of skills (i.e., performance of at least 80% correct) at the end of the semester. As shown in Table 2, approximately 90% of the students showed mastery on the syllable identification task. In contrast, only 27.2% of the students were able to consistently (i.e., at least 80% of the time) identify the number of phonemes per word. For orthographic knowledge, at the end of the semester, 63.3% of education students scored more than 75% correct on this task (i.e., score of at least 3 correct out of the 4 items).

	Time 1	Time 2	Improvement <i>p</i>
n	294	158	
Syllables (max 10)	9.04 (1.44) 0 - 10	9.07 (1.43) 0 - 10	.859
No. of sounds (max 10)	2.18 (2.53) 0 - 10	4.98 (3.29) 0 - 10	< .001
2nd sound in word (max 5)	1.84 (1.21) 0 - 5	2.78 (1.31) 0 - 5	< .001
Last sound in word (max 5)	3.02 (1.05) 0 - 5	3.49 (0.87) 0 - 5	< .001
Rhyming words (max 4)	3.33 (1.08) 0 - 4	3.65 (0.65) 0 - 4	<.001
Same initial sound – not letter (max 4)	2.30 (1.53) 0 - 4	3.14 (1.53) 0 - 4	<.001

Table 1: Student performance at the start (time 1) and end (time 2) of their first semester of study

	Time 1	Time 2
n	294	158
No. of syllables	90.1%	89.2%
No. of sounds	6.8%	27.2%
2nd sound in word	9.9%	34.8%
Last sound in word	36.4%	58.9%
Rhyming words#	88.4%	98.1%
Same initial sound –not letter #	38.8%	63.3%

scores > 75%

Table 2. Percentage of students showing mastery (> 80%) at the start and at the end of the semester

Quiz Attempts and Results

Overall, there were 2,673 attempts in completing the 20 question quiz, ranging from 1 to 31 attempts per student. All 238 students who were still enrolled in the course at the end of the semester completed the quiz (total 2153 attempts). Average score on the first attempt was 55.53% (11.05 out of 20; SD 3.59, range 0 – 19); average score on the final attempt was 90.1% (18.19 out of 20; SD 1.84, range 6 – 20). Only 3.7% of students passed the quiz (i.e., $\geq 90\%$; 18 out of 20 questions correct) on their first attempt, whereas 90% of students passed the test on their final attempt. To determine if there was a learning effect for individual students, two students who attempted the quiz more than 10 times were randomly selected. As shown in Figure I, both students gradually improved their performance with each attempt and stopped when they reached the pass criterion.

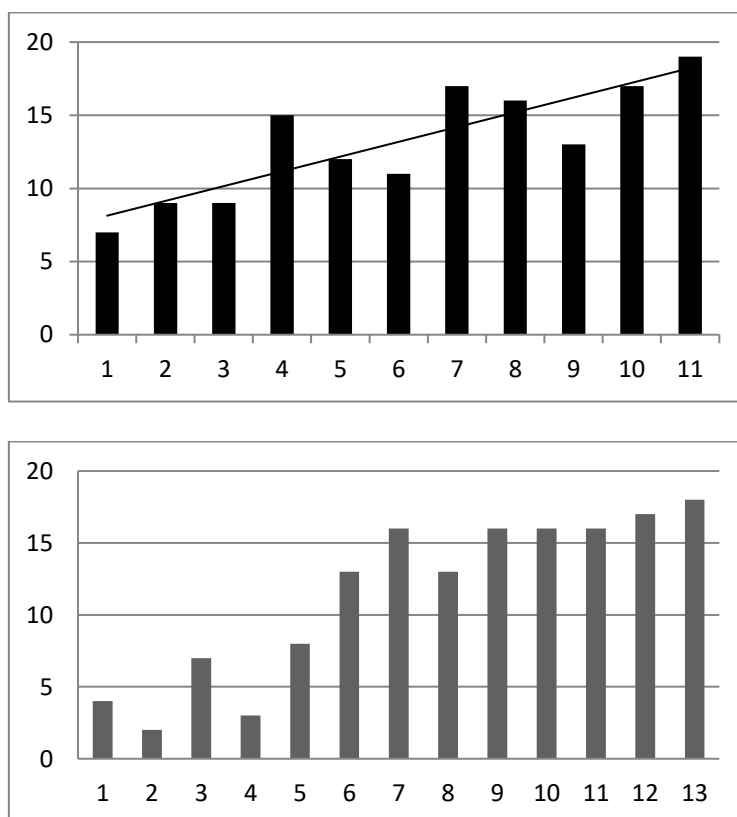


Figure 1: The performance of two students on the online quiz in number of questions correct (out of 20) for each attempt

Discussion

To address the need for appropriate training of our next generation of teachers of reading (Moats, 2014), we investigated the effectiveness of a relatively small change in coursework for first year Bachelor of Education students, related to two ingredients that are crucial to the reading process: phonological awareness and orthographic knowledge. As expected and consistent with previous studies into the phonological awareness and orthographic knowledge of preservice teacher education students, students performed well on syllable awareness at the start of the semester, one of the earliest developing levels of phonological awareness (Lonigan, Burgess, Anthony, & Barker, 1998). However, the students performed low on phoneme level phonological awareness tasks such as identifying the first and second sound in the word and indicating the number of sounds in words (e.g., Clark et al., 2017). The level of performance in this cohort of education students was very similar to that of the previous cohort as reported in our pilot study (Westerveld & Barton, 2016), confirming that these low levels of performance in phoneme awareness are not a one-off phenomenon. Apart from phonological awareness skills, we also tested orthographic knowledge in a task requiring the students to identify words that started with the same sound (not letter). Average performance for the education students was around 50% correct, but the range in performance was wide with some students obtaining a score of 0 and some students achieving 100%.

Our overall aim of the study was to determine if there was an improvement in the phonological awareness and orthographic knowledge of preservice teacher education students following the introduction of two online modules with associated assessment tasks that specifically addressed these skills. When evaluating the students' progress at the end of the semester, significant improvements in performance were found on all measures of phonological awareness as well as the measure of orthographic awareness. Furthermore, the overall level of performance of the education students was notably higher compared to the previous cohort (as reported by Westerveld & Barton, 2016), who were not exposed to the online modules nor the assessment task and showed no improvement during their first semester of studies. For example, the current cohort achieved a mean score of 4.98 out of 10 when asked to identify how many sounds there were in a word, compared to a score of 2.0 out of 10 in our previous cohort (Westerveld & Barton, 2016). However, mastery levels in phonological awareness were still alarmingly low, with only 27.2% of education students able to identify the number of sounds in a word (compared to 10.3% in our previous cohort). Better performance levels were seen on the measure of orthographic knowledge, with 63.3% of students achieving > 75% correct when asked to match words that started with the same sound (not letter).

Consistent with assessment-driven learning (Biggs & Tang, 2011), our results showed that the students engaged with the online assessment task. On average, the students attempted the quiz 10 times, before they obtained the pass mark of 80% or above. Although we did not keep track of engagement with the online modules, we assume that many students attempted the quiz prior to working through the online modules, using a surface learning approach to completing the quiz (see Biggs & Tang, 2011). As outlined by Lublin (2003, p. 4), this surface approach may include memorising information needed for assessments; making use of rote learning; taking a narrow view and concentrate on detail; failing to distinguish principles from examples; tending to stick closely to the course requirements; and being motivated by fear of failure. Another reason for the high number of attempts could be the fact that students were unable to understand the topics deeply or they simply found the quiz difficult to complete.

Limitations

The survey was only completed by those students who attended the tutorials at the start and at the end of the semester. Although this represented 66% and 75% of the student cohort at time 1 and time 2, it is not clear if the performance reflects the full cohort. Furthermore, as in our previous study (Westerveld & Barton, 2016), we used the same survey at the start and at the end of the semester, which could have resulted in a practice effect. Even though our previous research did not show evidence of a practice effect, future research should consider the use of alternate forms. Attrition of students seemed relatively high, with 238 of the original 456 enrolments completing their first semester of study. Finally, we acknowledge that we only measured two skills that are deemed important to the reading process.

Implications and Future Directions

The results from this study are promising in that a relatively simple change to existing course work resulted in a significant improvement in preservice teachers' phonological awareness and orthographic knowledge. These results add to our limited knowledge base around the importance of specific course content and dosage as investigated by Clark and colleagues (2017). However, much work needs to be done. First, the range of performance was wide and the percentage of students showing mastery was not satisfactory. It may well be that more specific instruction in phonetic transcription is needed to facilitate greater gains in phonological awareness skills for all students (Robinson, Mahurin, & Justus, 2011).

Previous research also suggests that students who possess lower literacy skills prior to the intervention may not be as responsive as those who start their degree course with higher literacy skills (Purvis et al., 2016). Future work should consider whether further targeted and explicit instruction should be provided to those students who failed to make progress during their first year of study towards a Bachelor of Education. Second, we cannot assume that those students who showed mastery on the tasks (based on the survey results) may be able to effectively teach these rules in the classroom. In this study we tested implicit knowledge, that is the ability to apply their phonological knowledge, and did not appraise students' explicit knowledge of constructs or conventions (e.g., providing definitions). It is hypothesised that teachers who show an explicit understanding of these constructs may be best placed to provide effective reading instruction (Moats, 2014). In this way future work should not only incorporate measures of explicit knowledge of language structure, it should also investigate how best to observe pre-service teachers' application of their knowledge of the teaching of reading in the classroom (Tetley & Jones, 2014). In fact, evidence suggests a combination of coursework and targeted field experiences in the classroom context may be an effective way to support preservice teachers in becoming effective teachers of reading (Al Otaiba et al., 2012; Dawkins, Ritz, & Loudon, 2009).

The high number of quiz attempts was concerning and most likely reflected a surface approach to learning (Biggs & Tang, 2011). Considering a more extensive knowledge of the English language structure is needed for the teaching of reading (Moats, 1994), ensuring deeper engagement and understanding of language structures is essential. This would not only increase preservice teachers' self-efficacy on the teaching of reading, but should ultimately result in more positive literacy outcomes for students and consequently improve pathways for students for life beyond schooling.

Conclusion

Considering the importance of early reading success for future academic performance, vocational outcomes and social-emotional wellbeing, we agree with Stark et al. (2016) that we have an obligation to try and close the gap between the research findings on effective reading instruction and teacher preparation. The current reported time (less than 10%) that is allocated to teaching of reading in preservice teacher education programs is clearly not sufficient (Australian Government, 2015, p. 22), but simply increasing the amount of time spent on this area of coursework is not the only answer (Clark et al., 2017). We realise our current study is only a small piece in a political jigsaw puzzle around the teaching of reading. Regardless, we would like to take this opportunity to urge all stakeholders involved in the teaching of reading to work together towards a common goal; that is to improve preservice teachers' skills in areas such as phonological awareness and orthographic knowledge with the ultimate aim of raising the literacy skills of Australian primary school students.

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Appendix: Example Quiz Questions

Orthography

1. Identify the letters or letter combinations (graphemes) that correspond to the phonemes in the word **praise**.
2. When is the letter i before e spelled in a word?
3. What do the following words have in common: bail, nailed, train, maid
4. Identify the correct root-word and suffix for the word **beautiful**
5. Identify the origin of the word **knight**
6. Why is the consonant doubled in the word **propelled**
7. What sound/s does the letter combination **/qu/** represent?

Phonological Awareness

How many speech sounds are in the word:

- Dough
- Naughty

What is the first sound in the word:

- Room
- Knife

What is the second sound in the word:

- Two
- Table

What is the third sound in the word:

- Room
- Box