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Providing English foreign language teachers with content knowledge to facilitate decoding and spelling acquisition: a longitudinal perspective

Janina Kahn-Horwitz[1,2]

Abstract This quasi-experimental study adds to the small existing literature on orthographic-related teacher knowledge in an English as a foreign language (EFL) context. The study examined the impact of a course on English orthography on predominantly non-native-speaking EFL preservice and inservice teachers' orthographic content knowledge, and the extent to which these teachers retained orthographic-related content knowledge four months after participating in a semester course on the topic. In addition, the study examined the relationship between participants' acquired orthographic-related content knowledge and EFL spelling. Both groups of teachers that studied in the course improved on overall orthographic-related content knowledge, both immediately following the course and longitudinally. Preservice and inservice participants showed similar levels of orthographic knowledge prior to course participation and both showed significant improvements compared to controls following course participation. Participants also retained knowledge four months after course completion. Overall, the inservice teachers scored higher on orthographic-related knowledge, possibly as a result of the immediate application of their newly acquired knowledge. An unexpected finding was a lack of interaction between acquired orthographic-related content knowledge and pseudo word spelling scores. Possible methodological limitations, such as number of participants as well as the length and scope of the course, may explain this outcome. This paper also discusses practical implications of this study for EFL decoding and spelling instruction.

✉ Janina Kahn-Horwitz
   janina_k@oranim.ac.il

1   Department of Language Learning, Oranim Academic College of Education, Kiryat Tivon 3600600, Israel

2   Department of Learning Disabilities, Edmond J. Safra Brain Research Center for the Study of Learning Disabilities, University of Haifa, Haifa, Israel

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This study is the second of two examining the impact of a semester course focusing on English orthography on English as a foreign language (EFL) teachers in Israel. Hebrew is the first (L1) and Arabic is the second official language of Israel. English is studied as a compulsory foreign language from early elementary school until graduation from high school. Although English is considered a foreign language and is studied as such in schools, English proficiency is considered extremely important as a global language; it gives a person greater mobility and higher status in Israeli society (Shohamy, 2014). English knowledge specifically gives a person greater opportunities in education, career, business, and travel. English academic knowledge is considered to be an entry ticket to higher education. Both matriculation and the high-stakes psychometric examinations include significant sections in English, and acceptance to higher education is dependent on results of these examinations. This gateway to higher education remains an obstacle for many children in Israel, who never acquired adequate English proficiency, partially due to insufficient decoding and encoding skills.

How L1 learners learn to read and spell English

Children acquiring reading and spelling in L1 English need print awareness, which implies knowing what print is and why it is useful, as well as print concepts which are specific to English orthography. In addition to developing phonemic awareness, students need to acquire English alphabetic knowledge, which includes grapheme-phoneme correspondence, such as all the respective digraphs, trigraphs, and quadrigraphs. This knowledge facilitates their becoming efficient phonological decoders (Vellutino, 2003). Children use phonemic awareness, knowledge of phoneme-grapheme, grapheme-phoneme correspondence, and rapid processing, to spell and read words (Berninger, Abbott, Thomson, & Raskind, 2001). Knowing how to spell is not only important in writing English, but also in reading words (Treiman, 1998). Initial spelling of a word entails analyzing it into its respective phonemes and then representing each phoneme with the appropriate grapheme (Weiser & Mathes, 2011). This application of the alphabetic principle has been shown to assist children in Hebrew L1 orthographic learning (Shahar-Yames & Share, 2008) for words with consistent grapheme-phoneme correspondence, as well as words with partially regular and partially irregular grapheme-phoneme correspondences. This process leads to the acquisition of these words as sight words.

When children are initially exposed to an unknown word, they will use orthographic mapping to associate graphemes with phonemes, provided they have been taught the respective grapheme-phoneme correspondences making up the English orthography. They will blend the phonemes together and pronounce the word. If the child understands English, the word will then be associated with a meaning (Ehri, 2014). Children may alternatively use an analogy strategy or successfully predict the word using initial letter identification and context (presumably more in the case of L1 English) to identify the word. The student may identify the word using orthographic mapping a few times, a process referred to as self-teaching (see Share, 1995), until the student can read the word with automaticity.

Connectionist theories explain how the phonology and orthography in high-frequency words serve to strengthen the lexical representations of a word in the mind of the reader

(Adams, 1990; Ehri, 2014). These two processes underlie spelling and word reading, both of which involve the utilization of the alphabetic principle. Berninger et al. (2001) demonstrate that a phonological component accounts for reading accuracy, comprehension, spelling, and composition in children with reading disabilities. In a synthesis of best practice studies, Weiser and Mathes (2011) examined the efficacy of interventions involving both spelling and word reading components on children with difficulties in spelling and reading. They showed that adding spelling-related instruction to these interventions enables these children to become adept at the alphabetic principle and to make the connections between these foundation skills and reading comprehension. Similarly, in a wide-scale study, including a very large sample of 875,040 pupils, Foorman and Petscher (Foorman and Petscher, 2010) showed a strong connection between spelling ability and basic level reading comprehension for third to sixth graders and between spelling ability and reading comprehension for seventh to eleventh graders.

How EFL learners learn to read and spell English

In contrast to beginner English L1 readers, typically developing children who are learning to read and spell in EFL presumably already have experience with reading and spelling in their first language. They have most likely developed awareness of print, phonology, and orthographic knowledge in their L1. Word recognition and spelling of words include being able to pronounce the word, understand meanings associated with it, and identify morphemes that make up the word. These word knowledge components have been found to predict both decoding and spelling in English L1 (Mahony, Singson, & Mann, 2000) and EFL (Kahn-Horwitz, Shimron, & Sparks, 2006; Kahn-Horwitz, Sparks, & Goldstein, 2012). When children acquire EFL decoding and spelling, they are likely to have a much less developed knowledge of English phonology, orthography, and morphology. In addition, they may only be familiar with one meaning associated with a specific word. These are all limitations associated with the acquisition of an entirely new language and literacy.

When facilitating early reading and spelling acquisition, one needs to consider not only orthographic-related content knowledge as a factor contributing to EFL decoding and spelling but also the depth that characterizes the English orthography. The English orthography is considered to be opaque in that there exists a one-to-many correspondence between graphemes and phonemes, and phonemes and graphemes (Frost, 2005; Seidenberg, 2013; Venezky, 1999). As a result, acquisition of decoding is a prolonged process for English L1-speaking children (Seymour, Aro, & Erskine, 2003) and English second language learners (Gunderson, Murphy Odo, & D'Silva, 2011). The acquisition of basic levels of spelling for children for whom English is a foreign language is a similarly long process (Kahn-Horwitz et al., 2012; Russak & Kahn-Horwitz, 2015). In addition to the aforementioned challenges associated with English literacy acquisition, EFL students spend far fewer hours studying the English language and literacy than studying their first language and literacy.

The role of teacher knowledge in facilitating L1 learners' reading and spelling acquisition

Although it has been argued that teacher content knowledge is a significant factor in teacher instruction which is expected to impact the literacy acquisition of L1 English-speaking

children and bilingual children acquiring English literacy, few empirical studies to date have actually linked teacher content knowledge of language and literacy concepts to child outcomes (Carreker, Neuhaus, Swank, Johnson, Monfils, & Montemayor, 2007; Cunningham, Etter, Platas, Wheeler, & Campbell, 2015; Piasta, McDonald Connor, Fishman, & Morrison, 2009). Nonetheless, a strong case has been made for providing teachers with content knowledge as stated by Moats (2014) "A well-prepared teacher…must have a solid grasp of both the complexities of English orthography and the language systems that print represents in order to teach students recognition of written words" (p. 78). Teacher content knowledge is expected to influence instructional practice and instructional practice makes a significant impact on literacy outcomes. In their large-scale study of more than 50,000 classrooms, Foorman and Petscher (2010) found that teacher instruction made a greater difference to children's spelling performance than the school they attended.

Teacher preparation programs are expected to provide preservice teachers with high-quality pedagogical and in-depth discipline-related content knowledge in the fields they will teach, together with practical experience (Feuer, Floden, Chudowsky, & Ahn, 2013). Al Otaiba (2005) found that practice teaching improved word-related content knowledge for preservice teachers. Inservice teachers may teach orthographic-related content knowledge when facilitating children's reading and spelling acquisition. This may explain how, in an English L1 context, Mather, Bos, and Babur (2001) found that inservice teachers outperformed preservice teachers on a survey examining their knowledge of the structure of the English language, although the inservice teachers did not score higher than 68 %. Bos, Mather, Dickson, Podhajski, and Chard (2001) examined differences between preservice and inservice teachers' orthographic-related knowledge. They found that most participants succeeded in defining a phoneme, identifying short vowel sounds, and identifying two words that started with the same sound. Despite this success, both preservice and inservice teachers scored below 66 % on questions related to phonological awareness, terminology, and orthographic conventions, with inservice experiencing greater success than preservice teachers, and more experienced inservice teachers outperforming their less experienced peers.

In addition to English language content knowledge having a possible impact on English teacher instruction, extant literature has demonstrated the impact of English teacher spelling skills on English teacher instruction and subsequently on English-speaking children's spelling outcomes. Kroese, Mather, and Sammons (2006) examined the relationship between pseudo word spelling by L1 English kindergarten to third grade teachers and the spelling outcomes of their pupils. In this small study, they found that pupils whose teachers had poorer pseudo word spelling scores had poorer spelling scores than pupils who were taught by teachers with higher pseudo word spelling scores.

For over two decades, research has examined teacher knowledge of orthographic-related content essential for teaching word reading and spelling (Cunningham et al., 2015; Mather et al., 2001; Moats, 1994; Spear-Swerling & Brucker, 2003). This research has resulted in policy-related papers arguing that English language teachers should have a strong foundation of both orthographic knowledge and knowledge of the different language components that underlie English literacy. This foundation is crucial to success in facilitating English reading and spelling acquisition (Brady & Moats, 1997; Lyon & Weiser, 2009; Moats, 2014).

Despite the evidence and recommendations for the field, few English language teachers appear to have the necessary language-based content knowledge to facilitate literacy acquisition of English L1 populations including children with reading difficulties (Moats, 2009; Moats, 2014). A significant proportion of early childhood educators in an L1 English setting

expressed a desire for more content knowledge regarding the precursors and components of English literacy. They struggled to identify the number of syllables in shorter words, and the majority of participants were unable to identify the number of morphemes in any given word. In addition, many errors were noted in their attempts to phonemically analyze words (Crim, Hawkins, Thornton, Boon Rosof, Copley, & Thomas, 2008). In English L1 contexts, teachers seem to demonstrate a lack of adequate knowledge of language components necessary for facilitating reading and spelling acquisition (Moats & Foorman, 2003; Spear-Swerling & Brucker 2003).

The role of teacher knowledge in facilitating EFL learners' reading and spelling acquisition

In contrast to the quantity of research regarding English L1 preservice and inservice teachers' language-related content knowledge, minimal research has been conducted regarding EFL teachers' language-based content knowledge and their teaching of decoding and spelling (Goldfus, 2012; Kahn-Horwitz, 2015; Roffman 2012). EFL pre- and inservice teachers had similar results to English L1 teachers (Mather et al., 2001) regarding orthographic-related knowledge prior to participating in a professional development program (Roffman, 2012). Both groups showed significant improvement on posttests examining orthographic-related knowledge, specifically with regard to phonics, differentiation between syllables, and terminology (Roffman, 2012). Posttest results found less of an improvement in syllable count, spelling rules, and knowledge of vowels, and spelling rule improvement was rather minimal (Roffman, 2012).

Even more so than in the case of L1 English research, there is a need for research regarding the impact of orthographic-related content knowledge of EFL teachers on their EFL pupils' decoding and spelling acquisition. The result of such research could be compared with findings on English L1 teachers' language-based content knowledge, reading and spelling instruction, and ultimately, early literacy outcomes. In the extant research, experienced teachers in EFL settings showed limited knowledge of language components necessary for reading and spelling acquisition (Goldfus, 2012; Kahn-Horwitz, 2015, 2015; Roffman, 2012), similar to L1 findings (Bos et al., 2001; Crim et al., 2008; Mather et al., 2001; Moats 2004; Moats & Foorman, 2003; Spear-Swerling & Owen Brucker, 2003).

EFL teachers need to differentiate clearly between each of these word knowledge dimensions in assessment and instruction contexts and across age and ability levels, in order to facilitate their EFL students' word reading and spelling acquisition. Effective teachers need to be steeped in sufficient English word-related content knowledge in order to provide their students with the necessary foundations to develop their English literacy (Adams, 1990, Moats, 2014). This is all the more crucial in EFL contexts and particularly with regard to children acquiring EFL reading and spelling as well as struggling readers.

The previous study

The previous related study was an attempt to address a broader challenge of L1 Hebrew-speaking and L1 Arabic-speaking children who reach junior high school after studying EFL for approximately four years, but do not have accurate enough decoding and spelling to be

considered EFL readers and writers. The first of the current two studies (Kahn-Horwitz, 2015) examined perceptions of EFL teachers regarding English decoding and spelling acquisition, as well as their knowledge of the English orthography before and after participation in a semester course on the topic. The focus was on preservice teachers who participated in a course on English orthography. Preservice teachers did not attain proficient knowledge of English orthography after participating in a semester course on the subject matter. Nevertheless, they performed significantly better than a control group of preservice and inservice teachers that did not participate in a course on English orthography.

The current study

The current study sought to broaden the scope of the original study. This study compared two parallel groups, one of inservice teachers studying towards their M.Ed. in Language Teaching, and the second of preservice teachers. The two groups participated in parallel courses taught by the same instructor that focused on the same orthographic content and the challenges of English spelling. In addition, the current study examined results from a longitudinal perspective, by testing the two groups of course participants immediately before and after participation in the course, as well as four months after participation. This longitudinal approach is intended to demonstrate the extent to which knowledge was thoroughly acquired during the course and remembered for further instructional purposes. Finally, the current research examined whether participation in the course had any impact on participants' English spelling.

One obstacle to EFL acquisition is the relatively few hours of instruction allocated to EFL studies in contrast to L1 studies.[1] Many schools in Israel begin EFL instruction in second or third grade, with children studying two to three weekly hours. In response to minimal weekly instructional hours and limited linguistic background knowledge, teachers need to exploit every minute of EFL literacy teaching time. Therefore, it is important for current and future EFL teachers to have the content knowledge to be able to explain the linguistic source of decoding or spelling errors. This knowledge helps teachers guide pupils towards accurate and fluent reading and spelling.

Preservice and inservice teachers in English L1 (Mather et al., 2001) and EFL contexts (Roffman, 2012) improved English language and orthographic content knowledge after participating in courses teaching these concepts. At the outset of this study, both pre- and inservice teachers were expected to show an improvement in their orthographic knowledge following participation in the course on this content, although it was unclear as to whether and to what degree this knowledge would be retained.

In English L1 contexts, inservice teachers outperformed preservice teachers on knowledge of English language concepts (Bos et al., 2001; Mather et al., 2001). This was not found to be the case in an EFL context (Roffman, 2012). The current study attempts to explore differences between inservice and preservice teachers on their knowledge of English language concepts.

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[1] The State of Israel Ministry of Education Pedagogical Administration Planning, Management and Preparation Kits (2014–2015) recommends nine L1 weekly instructional hours in third grade, seven in fourth grade, and six in fifth and sixth grade (this includes all language arts in either Hebrew or Arabic L1). The same document recommends four EFL weekly instructional hours starting in fourth grade and continuing in fifth and sixth grade. The document states that allocation of these hours may be manipulated within a 25 % range (State of Israel Ministry of Education Pedagogical Administration, 2014).

In an English L1 context, preservice teachers improved their orthographic-related content knowledge following their successful supervised teaching of struggling English language learners (Al Otaiba, 2005). This experience of teaching components of English orthography, in parallel to studying orthographic-related knowledge, may bootstrap the content knowledge for the individual teacher. This led to the hypothesis that, when comparing the two groups of participants in a course on English orthography, inservice EFL teachers would show an advantage over preservice teachers in their orthographic content knowledge, as the preservice teachers in the current study were in the first year of their studies and were still not teaching.

In English L1 contexts, English language arts teachers can be assumed to have a reasonable command of English spelling. This is not necessarily the case in EFL contexts. Furthermore, this difficulty with English spelling is apparently not a result of having difficulty with spelling across languages (including L1). A group of predominantly non-native EFL preservice teachers rated their EFL spelling as being significantly poorer than their L1 spelling ability (Kahn-Horwitz, 2015). Had they claimed that their L1 spelling ability was poor, one would expect that underlying difficulties expressing themselves in L1 would express themselves in EFL as well, based on theories such as *the linguistic coding differences hypothesis* (Kahn-Horwitz et al., 2006). However, this group claimed that despite good spelling skills in their L1, their English spelling was poor. This could be a result of the characteristics of the English orthography mentioned above, as well as receiving less explicit spelling instruction during their formal study of English. A hypothesis of the current study was that an improvement in scores of orthographic knowledge would be coupled by an improvement in pseudo word spelling.

Questions in this study

1. To what extent does a semester course on English orthography improve knowledge of concepts related to the English orthography of preservice versus inservice EFL teachers, as compared to controls?
2. To what extent do preservice versus inservice EFL teachers retain the orthographic-related knowledge gained through participation in the course, as compared to controls?
3. To what extent does orthographic content knowledge acquired by preservice versus inservice EFL teachers during a course on English orthography impact EFL spelling?

Method

This was a quasi-experimental research design using a quantitative longitudinal design, whereby participants completed tests prior to participation in a semester-long course, immediately after the semester course, and four months after participating in the course. The advantage of a longitudinal design is the possibility it provides "to investigate the time-course of individual learners' development to gain insights into their acquisition mechanisms" (Eisenbeiss, 2010, p. 17). In the case of this particular study, the longitudinal design enabled the study to examine whether content knowledge studied in a course on the English orthography was remembered four months later.

Participants

A total of 106 preservice and inservice teachers took part in this study (see Table 1). The semester course on issues associated with English orthography was offered as an elective course in both programs. Students usually enroll in a course either because the topic interests them and/or because the timing is convenient for them. Overall, 101 participants took part in initial precourse testing, 94 took part in immediate post course testing, and 98 took part in testing four months after participating in the course.

Seventy participants were preservice teachers who were in their first or second year of studies towards a B.A. in English Language and Literature and Teaching Certification. From this preservice teacher group, 41 enrolled in the elective semester course about English orthography and 29 did not participate in the course. The second group consisted of 44 inservice teachers working on their M.Ed. in Language Teaching, of which 28 enrolled for an elective semester course on English orthography, and 16 did not participate in this course.

See Table 1 for a breakdown of background variables including: L1, years of being exposed to the English language at school, years of being exposed to English reading and spelling at school (this was included as an additional question because English instruction often begins with about one year of oral-aural acquisition prior to acquiring reading and spelling), and years of EFL teaching experience (mainly aimed at inservice teachers as preservice teachers had very minimal teaching experience), and self-rating of spelling in L1 and EFL. *T* tests examining

Table 1 Descriptive information regarding number of participants, years of school English study, teaching experience, and spelling rating

Number	Orthographic preservice	Preservice control		Orthographic inservice	Inservice control		Total
Preintervention	41	18		28	14		101
Postintervention	38	13		28	15		94
Post-postintervention	32	29		21	16		98
L1 Hebrew	21	11		5	2		39
L1 Arabic	16	6		19	12		53
L1 Russian	2	1		3	1		7
L1 Circassian	1	0		0	0		1
L1 English	2	0		2	0		4
L1 Other	0	0		2	0		2
Years	*M* (SD)	*M* (SD)	*t* (*df*)	*M* (SD)	*M* (SD)	*t* (*df*)	
English language studies at school	9.92 (1.42)	9.39 (1.46)	1.31 (55)	8.94 (1.60)	9.43 (1.09)	−1.05 (43)	
English reading and spelling studies at school	8.33 (2.43)	8.65 (2.00)	−.46 (51)	8.26 (1.83)	8.71 (1.00)	−.88 (43)	
English teaching experience	3.29 (4.79)	2.00 (2.24)	.55 (10)	12.18 (8.24)	9.46 (6.57)	1.04 (39)	
	M (SD)	*M* (SD)	*t* (*df*)	*M* (SD)	*M* (SD)	*t* (*df*)	
Self-rating[a] L1 spelling	1.23 (.49)	1.28 (.75)	−.26 (55)	1.16 (.45)	1.21 (.43)	−.37 (43)	
Self-rating EFL spelling	2.10 (.68)	2.11 (.76)	−.04 (55)	1.48 (.63)	1.50 (.52)	−.08 (43)	

[a] Rating on a scale of 1–4: 1 = excellent, 2 = good, 3 = average, 4 = poor

differences in background variables between preservice teachers that participated in the course on English orthography and preservice controls and between inservice teachers that participated in the course on English orthography and inservice controls did not yield any significant differences.

A minority of participants were native English speakers (two participants in the preservice teacher group, and two participants in the inservice teacher group). Although the four English speakers defined English as their first spoken language, English was not their first literate language. They acquired English literacy at the same time as their Hebrew L1-speaking peers. Hence, it was decided to include these participants in the sample. In addition, the distribution of the respective L1 speakers across the groups was relatively uniform. More specifically, though there were proportionally less Arabic L1 speakers in the preservice group than in the inservice group, each language was represented in the intervention and control group evenly.

Participants were told that the data was being collected in order to examine the course efficacy, and participants were given the option of not participating. None of the participants opted out of the research.

Measures

Background variables included information about first language, second and additional language, and literacy knowledge, EFL teaching experience, as well as self-rating of L1 spelling and EFL spelling. Dependent variables were target concepts and conventions regarding English orthography, and a spelling and pseudo word spelling test including the respective conventions that were taught in the course on English orthography. Independent variables were teacher status and participation in a semester course on English orthography (preservice enrolled in a course on English orthography, preservice not enrolled in a course on English orthography, inservice EFL teachers in a graduate program enrolled in a course on English orthography, and inservice EFL teachers not enrolled in this course).

Background questionnaire

Participants were asked to note their languages and literacy background in a short questionnaire that they filled in during the first data collection point. Questions also included number of years the participant had studied the English language and English reading and spelling at school, their L1 spelling ability as well as their EFL spelling ability rating, and years of teaching experience (if any).

Experimental measures

Teacher Knowledge Survey This survey was used in both related studies conducted by the author (Kahn-Horwitz, 2015). The survey is an adapted Teacher Knowledge Survey that uses items from the following Teacher Knowledge Surveys (which are primarily used for first language English language arts teachers: Bos et al. (2001); Carreker and Birsh (2005); Mather et al. (2001); Moats (1994); Moats (2009); Moats and Foorman (2003); and Piasta et al. (2009)) (see Appendix A). The following types of knowledge make up the survey: syllabic knowledge (16 items), orthographic conventions or phonics (12 items), terminology related to instructional practice (7 items), phonological awareness knowledge (9 items), and morphological awareness knowledge (4 items), Cronbach alpha = .83.

Experimental English real word spelling test The following stages were completed in the measure construction in order to increase the internal validity of this tool. The first was to target orthographic conventions based on the various syllable types and syllable division types in English orthography (Carreker & Birsh, 2005; Henry, 2003; Shankweiler & Fowler, 2004). Second, target words were extracted from the first 2000 most frequent English words in a Lexical Syllabus constructed for junior high school (Benisty, 2010). A contextual sentence was created for each word (see Appendix B). In scoring these words, a point was allocated for each orthographic convention spelled correctly.

The real word spelling test consisted of 25 items. A more sensitive scoring system was used in order to examine knowledge of the respective orthographic conventions in the 25 words. The maximum score for the fine-grained analysis of the words was 85. Eight orthographic conventions with at least five items for each convention were targeted (short vowels in closed syllables, unvoiced digraph <th>, split digraph (silent e), diphthong <ou>, digraph <ck>, soft/hard <c> and <g>, geminates, and unstressed schwa sounding vowel). One point was allocated for each orthographic convention spelled correctly, so that in a given word containing two target orthographic conventions, a point was allocated for each. For example, the word *thick* received one point for correctly spelling according to the traditional scoring system and three points for correct spelling according to the more fine-grained analysis, for digraph <th>, digraph <ck>, and short vowel in a closed syllable.

The tester read each target word to the participants and control groups. The tester then read the contextual sentence. After the participants and controls heard the contextual sentence, the tester repeated the target word. Lastly, the participants and controls wrote the word. This procedure is a customary routine for dictating words in a standardized test designed for English L1 speakers. See, for example, Larson, Hammill, & Moats (2013), Cronbach alpha = .69.

Experimental English pseudo word reading test Using the items from the real word spelling test presented above, a pseudo word was created based on each real word (see Appendix C). For the pseudo words, the tester repeated each word aloud twice to the group, and the participants and controls wrote down each pseudo word. For the scoring of the pseudo words, as in the scoring for the real word spelling, a point was allocated for each orthographic convention spelled using one of the legal possibilities. The pseudo words consisted of 25 items, and the maximum fine-grained score for this task was 86. The same eight orthographic categories, with at least five items in each category, were targeted (short vowels in closed syllables, unvoiced digraph <th>, split digraph (silent e), diphthong <ou>, digraph <ck>, soft/hard <c> and <g>, geminates, and unstressed schwa sounding vowel; Cronbach alpha = .71).

Four of the target orthographic patterns for the experimental real word spelling and pseudo word spelling tests were shown to be challenging for EFL 10th grade students in a previous study on EFL spelling (Russak & Kahn-Horwitz, 2015). The construction of the two abovementioned tasks was based upon the method of construction used in the aforementioned research.

Procedure

Data was collected over two years, including two rounds of course participation for both preservice and inservice teachers. Control participant group testing took place within the same time range as experimental participant testing. Some of the first round of data collected from

the first year of course participation (40 out of 70 of the preservice participants at two points out of three, pre- and postcourse participation) was published in Kahn-Horwitz, 2015. In the current study, participants answered background questions, filled in the adapted Teacher Knowledge Survey, and spelled real and pseudo words that were dictated to them during group sessions of approximately 50 min. This took place at the beginning of the 14-session course on orthographic-related conventions, at the end of the course, and four months after participating in the course.

The same instructor taught the two parallel courses for preservice and inservice teachers, and the courses targeted the same orthographic conventions. Each weekly session lasted an hour and a half. The instructor explained and reviewed definitions of concepts. The class discussed each letter of the alphabet, including the various phonemes associated with that letter and specific conventions associated with it. Examples discussed included the long and short sound of each vowel letter, the schwa sound, and the convention that the letter <c> often has the /s/ phoneme before the letters <e>, <i>, and <y>. The class also discussed respective orthographic patterns, including consonant and vowel digraphs, e.g., <ch> and <ai>, trigraphs and quadrigraphs, common rimes, and consonant clusters.

These discussions took place from a cross-linguistic and cross-literacy perspective. In other words, the course highlighted novel phonemes and graphemes for children with a Semitic language background and included suggestions for helping children cope with these novel characteristics. For example, the voiced and unvoiced /th/ are novel for L1 Hebrew speakers, but familiar to L1 Arabic speakers. The novelty of the /th/ for L1 Hebrew speakers often results in decoding and spelling errors (Kahn-Horwitz, Schwartz, & Share, 2011; Russak & Kahn-Horwitz, 2015). Students practiced using their articulators (mouth, teeth, and tongue) to demonstrate pronunciation of the /th/ phoneme.

The course examined different origins of English words, including Anglo-Saxon, Latin, and Greek origins. The course gradually introduced students to six different syllable types, together with implications for the vowel sounds. Students studied syllables and practiced characterizing them. Following syllable types, students gradually gained understanding of five types of syllable division and practiced dividing up multisyllabic words. Students examined words with irregular grapheme-phoneme correspondences, e.g., *one*, and were expected to recognize what was irregular about the word. Students studied common affixes along with their meanings. They read relevant literature on the topics for classes and discussed these readings in class. In addition, students took short quizzes every three weeks in order to practice the concepts studied.

Results

As described above, this study examined the impact of participating in a semester course about English orthography on preservice versus inservice EFL teachers, compared to controls who did not participate in the course. More specifically, the study looked at the extent to which the course improved knowledge of concepts related to English orthography, the extent to which this content knowledge was retained after an additional semester, and the impact of studying English orthographic content knowledge on EFL spelling.

The level of success was treated as a count variable that aggregates times of successful answers. As reported in the first of these two studies, when analyzing scores from the first two stages of data collection in the first year (Kahn-Horwitz, 2015), a preliminary test indicated

over dispersed count variables. Therefore, a negative binomial distribution analysis was chosen, because this analysis resulted in a better fit in comparison with a linear regression. In addition, a generalized estimated equation procedure was chosen, because this facilitates both negative binomial distribution and cases with missing data. This was followed by post hoc Bonferroni's pairwise tests (Garson, 2012; Lipsitz & Fitzmaurice, 2009).

The following results answer the first and second questions regarding the extent to which a semester course on the English orthography improved content knowledge of preservice versus inservice teachers and the extent to which this content knowledge was retained after four months. A preliminary ANOVA comparing research measures prior to the intervention showed that there were no significant differences between the four groups for any of the measures (see Table 2). The regression analysis found interactions for two out of three dependent variables by program and time (see Table 3). That is, the four groups showed differences between times for overall orthographic knowledge and pseudo word spelling.

Table 4 shows mean differences and standard errors for the four groups at the three times. According to Bonferroni post hoc tests (see Table 5), the preservice teachers who participated in the course on English orthography showed a significant improvement in overall orthographic knowledge from pre- to post participation in the course. Their advantage remained four months later (see Table 5). Similar to their preservice peers, the inservice teachers who participated in a course on English orthography showed a significant improvement in their overall orthographic knowledge from pre- to post participation in the course. Inservice teachers outperformed preservice teachers on the measure testing orthographic content knowledge immediately after participating in the course. For the inservice group, results four months later showed a significant decline in overall orthographic knowledge. However, despite this decline, there was still a significant improvement from precourse participation to testing four months after course participation. The advantage of inservice over preservice teachers who participated in the course was not maintained four months later. Neither preservice nor inservice groups that did not participate in a course on English orthography showed any significant improvement in orthographic content knowledge. This implies that participation in the course on English orthography impacted preservice and inservice teacher content knowledge.

The third question examined the impact of English orthographic content knowledge on EFL spelling (see Table 6). English orthographic knowledge had no main effect on real word spelling. In addition, the study found no two- or three-way interactions between time, program, and orthographic knowledge on real word spelling. The mean score was close to ceiling, 82.95 out of a maximum of 85 (see Table 3). However, the study found a significant main effect for English orthographic knowledge acquired while participating in the course on pseudo word spelling ($b = .001$, $p < .05$). In addition, the study found a two-way interaction between time and program for pseudo word spelling.

Table 2 Preliminary comparison of preintervention research measurements		*Wald*	*p*
	Orthographic knowledge	2.31	.51
	Word spelling	0.15	.99
	Pseudo word spelling	0.17	.98

Table 3 Regressions for orthographic knowledge and real and pseudo word spelling by groups and times

	Orthographic knowledge	Real word spelling	Pseudo word spelling
Means	22.77	82.95	75.63
SD	9.13	2.63	6.11
Range	5–43	70–85	58–86
Items	46	85	86
Model 1—main effects			
Constant	3.10*** (.06)	4.43*** (.01)	4.36*** (.01)
Program	Wald = 63.84***	Wald = 26.65***	Wald = 22.59***
Orthographic preservice vs inservice controls	.05, .05 (.07)	−0.03***, .03 (.01)	−0.04**, .04 (.02)
Preservice controls vs inservice controls	−.14, .13 (.08)	−.01*. .01 (.02)	−.04*, .04 (.02)
Orthographic inservice vs inservice controls	.31***, .36 (.06)	.001, .00 (.01)	.02, .02 (.01)
Time	Wald = 124.43***	Wald = 7.07*	Wald = 53.31***
Time 1 vs time 3	−.34***, .29 (.04)	−.01**, .01 (.003)	−.05***, .05 (.01)
Time 2 vs time 3	.12**, .13 (.04)	−.004, .00 (.003)	−.00, .00 (.01)
Goodness of fit—QICC	42.72	12.25	13.55
Model 2—interactions			
Time X program	Wald = 83.07***	Wald = 9.64	Wald = 38.65***
Goodness of fit—QICC	51.02, α = .81	24.24, α = .69	25.46, α = .71

Effect size next to regression estimates (ES = exp (b) − 1, if b > 0, 1 − exp (b), if b < 0); standard error in parenthesis

*p < .05, **p < .01, ***p < .001

Table 4 Marginal means by time and program for research variables

	Time 1	Time 2	Time 3
Overall orthographic knowledge			
Orthographic preservice	14.60 (0.89)	29.06 (1.18)	24.51 (1.47)
Preservice controls	15.84 (1.13)	17.07 (1.55)	19.38 (1.28)
Orthographic inservice	20.31 (1.05)	36.11 (0.70)	29.53 (1.48)
Inservice controls	19.59 (1.40)	20.59 (1.09)	20.62 (1.98)
Word spelling (fine-grained)			
Orthographic preservice	80.88 (0.59)	81.99 (0.54)	82.45 (0.40)
Preservice controls	82.53 (0.49)	83.13 (0.45)	83.14 (0.38)
Orthographic inservice	84.09 (0.35)	83.72 (0.33)	84.12 (0.25)
Inservice controls	84.07 (0.22)	83.92 (0.33)	84.01 (0.49)
Pseudo word spelling (fine-grained)			
Orthographic preservice	70.12 (0.96)	75.80 (0.96)	76.05 (0.86)
Preservice controls	74.31 (1.13)	77.12 (1.56)	73.74 (1.31)
Orthographic inservice	77.30 (0.83)	78.36 (0.94)	80.17 (0.90)
Inservice controls	75.16 (1.12)	77.46 (0.74)	78.41 (1.33)

Standard errors in parentheses

Table 5 Bonferroni pairwise comparisons between time (1, 2, and 3) and program (1, 2, 3, and 4) for each variable with probability values

Overall orthographic knowledge

	P1T2	P1T3	P2T1	P2T2	P2T3	P3T1	P3T2	P3T3	P4T1	P4T2	P4T3
P1T1	<.001	<.001				.002	<.001	<.001		.001	
P1T2			<.001	<.001	<.001	<.001	<.001		<.001	<.001	.017
P1T3			<.001	.033			<.001				
P2T1							<.001	<.001			
P2T2							<.001	<.001			
P2T3							<.001	<.001			
P3T1							<.001	<.001			
P3T2								<.001	<.001	<.001	<.001
P3T3									<.001	<.001	.021
P4T1											
P4T2											
P4T3											

Word spelling (fine-grained)

	P1T2	P1T3	P2T1	P2T2	P2T3	P3T1	P3T2	P3T3	P4T1	P4T2	P4T3
P1T1	<.001	<.001					<.001	<.001			
P1T2		<.001	<.001	<.001	<.001	<.001	.002		<.001	<.001	<.001
P1T3			.001	.001	.044		<.001				
P2T1							<.001	<.001			
P2T2							<.001	<.001			
P2T3							<.001	<.001			
P3T1							<.001	<.001			
P3T2								<.001	<.001	<.001	<.001
P3T3									<.001	<.001	<.001
P4T1											
P4T2											
P4T3											

Pseudo word spelling (fine-grained)

	P1T2	P1T3	P2T1	P2T2	P2T3	P3T1	P3T2	P3T3	P4T1	P4T2	P4T3
P1T1	<.001	.001					<.001	<.001			
P1T2			.003			.006			.001	.03	
P1T3											
P2T1					.02		<.001	.006			
P2T2							<.001				
P2T3											
P3T1							<.001	.01			
P3T2									<.001	<.001	
P3T3									.001		
P4T1											
P4T2											
P4T3											

P1 preservice orthographic, *P2* preservice control, *P3* inservice orthographic, *P4* inservice control, *T1* pre-intervention time, *T2* post-intervention time, *T3* post-postintervention

Table 6 Regressions for real and pseudo word spelling by groups, times, and orthographic knowledge

	Real word spelling	Pseudo word spelling
Model 1—main effects		
Constant	4.42*** (0.007)	4.33*** (0.02)
Program	$Wald = 20.15$***	$Wald = 20.74$***
Time	$Wald = 3.93$	$Wald = 16.79$
Orthographic knowledge	0.00001 (0.0003)	0.001* (0.0005)
Goodness of fit—QICC	12.24	15.49
Model 2: 2-way interactions		
Time X program	$Wald = 5.06$	$Wald = 26.37$***
Time X orthographic knowledge	$Wald = 1.03$	$Wald = 3.81$
Program X orthographic knowledge	$Wald = 1.86$	$Wald = 4.23$
Goodness of fit—QICC	36.24	37.39
Model 3: 3-way interactions		
Time X program X Orthographic knowledge	$Wald = 9.84$	$Wald = 11.52$
Goodness of fit—QICC	48.23	49.35

Standard errors in parenthesis

***$p < .001$

Discussion

The current study supports the hypothesis that both pre- and inservice teachers would show an improvement in their orthographic knowledge following participation in a course that explicitly teaches content of English orthography. Participants in the course remembered the knowledge acquired during the course. Four months after completing the course, the preservice teachers retained their advantage, whereas the inservice group showed a significant decline in scores. However, the inservice group's results were still significantly higher than precourse participation. By reexamining teachers' orthographic knowledge four months after completing the course, and finding that participating preservice and inservice teachers still showed an advantage to controls, the study verified the extent to which knowledge was acquired during the course. The third hypothesis was not supported in this study. This hypothesis assumed that improvement in orthographic knowledge would be associated with an improvement in pseudo word spelling.

In answer to the first and second questions, this study showed that preservice teachers significantly improved in their orthographic knowledge following participation in a course on English orthography and retained that knowledge four months later, similar to findings reported by Roffman (2012). These results are congruent with the framework provided in the position paper, Evaluating Teacher Preparation Programs. This paper highlights the importance of providing preservice teachers with the necessary content knowledge to serve as building blocks for their professional development (Feuer et al., 2013).

Inservice EFL teachers who participated in the course on English orthography attained the highest scores regarding content knowledge, thus supporting Al Otaiba's (2005) findings that using acquired content knowledge while teaching improved teachers' knowledge. The inservice EFL teachers studied orthographic content while simultaneously teaching in the

field, enabling them to immediately apply their knowledge in the classroom. Classroom practice may have served as a bootstrapping device for inservice EFL teachers' orthographic content knowledge.

Despite the significant improvements, all participants had still not achieved ceiling results when tested on content knowledge of English orthography. These results reflect English L1 results (Mather et al., 2001) and remain a challenge for teacher education programs in EFL contexts. Teachers cannot be expected to teach the various language components that provide the foundation of decoding and spelling if they themselves struggle with these components (Moats, 2014). A longer and more intensive course may be necessary to facilitate thorough orthographic content knowledge acquisition for both preservice and inservice teachers. In order to maximize the orthographic knowledge benefits for preservice teachers, it might be advisable not to teach the course to preservice teachers during their first year of studies, because they do not do practice teaching during this year. Participation in a course of this nature in parallel to practice teaching would enable the preservice teachers to benefit from going out into the field and applying their recently acquired knowledge with real students in EFL classrooms who are in the process of decoding and spelling acquisition. Teaching would assist these preservice teachers in cementing their understanding of the respective orthographic-related conventions, similar to what supposedly occurred with the inservice teachers.

The findings indicate that both preservice and inservice EFL teachers lack orthographic knowledge at precourse testing, with no significant difference between the two groups. These findings are similar to Roffman (2012), who also examined preservice and inservice EFL teachers. EFL inservice teachers teach relatively few hours per week to each EFL class (State of Israel Ministry of Education Pedagogical Administration, 2014), and there are many language-related aspects that they need to teach. As a result, they may place relatively less of an emphasis on the building blocks of English orthography and subsequently their inservice experience may lead to modest improvements in this sphere. This in contrast to English L1 research where Mather et al. (2001) examined preservice and inservice teachers and found an overall orthographic knowledge advantage for experienced teachers.

At the immediate postcourse test time, inservice course participants significantly outperformed preservice course participants. This finding may be evidence of the benefits of teaching children in the field while taking the course. This newly acquired content knowledge may have served the participating teachers in effectively facilitating the decoding and spelling acquisition of their pupils (Carreker et al., 2007; Cunningham et al., 2015; Piasta et al., 2009). However, at the third testing time, four months after the course ended, although preservice and inservice teachers once again significantly outperformed their control peers, results were not significantly different between pre- and inservice teachers. The long-term benefit for both participating groups had leveled out. Further research would have to shed light on the reason for the significant decline in results for the inservice teachers despite their relative advantage to controls.

The third question for discussion was the impact of participation in a course on English orthography on preservice and inservice EFL teachers' spelling. The finding that performance of all four groups on real word spelling was relatively high may not be surprising considering that the words were frequent. Overall, participants received high scores in precourse testing, and scores remained high in post testing and four months after that. The unexpected finding that improvement in pseudo word spelling in the different groups was not connected to improvement in scores on orthographic-related components will need to be examined in the future.

A study that may illustrate the importance of EFL teacher pseudo spelling ability was conducted by Kroese et al. (2006) on English teachers of kindergarten to third grade children. They found that there were more successful spellers in classes with English teachers who had higher pseudo word spelling scores and less successful spellers in classes with English teachers who had lower pseudo word spelling scores. In the current study, both preservice and inservice groups rated their EFL spelling as being poorer than their L1 spelling. Providing these preservice and inservice teachers with orthographic-related knowledge was an important first step in becoming effective EFL literacy teachers. However, teachers' English spelling ability might be an additional factor that might need to be examined in the context of becoming more effective EFL literacy teachers.

One limitation of the present study was the number of participants in each group. A tendency towards an interaction between orthographic knowledge and pseudo word spelling was found, $Wald = 11.52$, $p = .07$. Larger numbers in each group might have facilitated the examination of the dynamic interaction between time, group, and orthographic knowledge (the time variant variable) on pseudo word spelling. In addition, a year course teaching the various aspects of English orthography, as opposed to a semester course, could positively impact the pseudo word spelling of participants.

Limitations and future directions

Despite the contribution of this study to understanding the process of EFL teachers acquiring orthographic-related content knowledge, the current study has a number of limitations. The quasi-experimental nature of this study and inherent potential for selection biases is a severe limitation. The study was limited to participants that enrolled for two consecutive years in elective semester courses that addressed issues related to English orthography. Although results presented in this study show no significant differences between participants and controls in both preservice and inservice groups, the elective nature of the course may have indicated that there were differences between those that chose to participate in the course and those that did not. In addition, there were relatively small numbers of participants in each group. As a result of this manner of participant selection, it was not possible to include a set number of participants from the same L1 background in each group. Most of the participants were from Semitic language backgrounds. However, differences have been found in linguistic and orthographic parameters in elementary school children that come from different Semitic backgrounds (Kahn-Horwitz, Kuash, Schwartz, & Ibrahim, 2014). These differences may be a factor that needs to be considered in future studies of this nature.

The participants in the current study were tested four months after having completed the course on English orthography. It would have been of value to examine preservice and inservice teacher orthographic-related knowledge six months to a year after participating in the course. Another limitation in the current study is that the preservice teachers did not have opportunities to apply their knowledge by teaching the concepts to children and receiving feedback from their instructor. In addition, while the inservice teachers informally reported on using knowledge acquired from the course on English orthography in their daily EFL teaching, the scope of the current study did not facilitate following up these reports in a systematic manner. It would be worthwhile to examine classroom outcomes from a course of this nature in future studies.

Appendix 1

Adapted teacher knowledge survey

1. Which word begins with an open syllable, long vowel?

   a) favor b) pleasant c) sunny d) planet

2. Which word contains a short vowel sound?

   a) treat b) start c) slip d) paw e) father

3. A phoneme refers to

   a) a single letter b) a single speech sound c) a single unit of meaning d) a grapheme

4. A pronounceable group of letters containing a vowel sound is

   a) phoneme b) grapheme c) syllable d) morpheme

5. If *tife* were a word, the letter *i* would probably sound like the *i* in

   a) if b) beautiful c) find d) ceiling e) sing

6. All of the following are irregular, high frequency words except:

   a) when b) does c) who d) said

7. A diphthong is found in the word

   a) room b) boy c) battle d) sing e) been

8. A voiced consonant digraph is in the word

   a) think b) ship c) boy d) the e) photo

9. Two combined letters that represent one single speech sound are a

   a) schwa b) consonant blend c) phoneme d) digraph

10. How many speech sounds are in the word *eight*?

    a) two b) three c) four d) five

11. How many speech sounds are in the word *box*?

    a) one b) two b) three c) four

12. How many speech sounds are in the word *grass*?

    a) two b) three c) four d) five

13. A nonsense word that does not follow English spelling pattern is:

    a) shease b) toyn c) squive d) clow

14. What type of task would this be? "I am going to say a word and then I want you to break

    the word apart. Tell me each of the sounds in the word *dog*."

    a) blending b) rhyming c) segmentation d) deletion

15. What type of task would this be? "I am going to say some sounds that will make one

    word when you put them together. What does /sh/ /oe/ say?"

    a) blending b) rhyming c) segmentation d) manipulation

16. Which of these words is NOT a silent-e syllable?

    a) time b) peace c) drove d) wage

17. What is the rule for using a *ck* in spelling?

    a) when the vowel sound is a diphthong b) when the vowel sound is short c) when the

    vowel sound is long d) any of the above

18. Count the number of **syllables** in the word *unbelievable*.

    a) four b) five c) six d) seven

19. Count the number of **syllables** in the word *pies*.

    a) one b) two c) three d) four

20. Count the number of **syllables** in the word *walked.*

    a) one b) two c) three d) four

The next two items involve saying a word and then reversing the order of the sounds.

For example, the word *back* would be *cab.*

21. If you say the word, and then reverse the order of the sounds, *ice* would be

    a) easy b) sea c) size d) sigh

22. If you say the word, and then reverse the order of the sounds, *enough* would be

    a) fun b) phone c) funny d) one

23. What is the second speech sound in the word *queen*?

    a) u b) long e c) k d) w

24. What is the third speech sound in the word *wretch*?

    a) ch b) e c) t d) r

25. In the word *crouch*, the *cr-* part is called the

    a) rhyme b) initial phoneme c) rime d) morpheme e) onset

26. In language, a single unit of meaning is called a

    a) grapheme b) syllable c) rime d) morpheme e) phoneme

27. In the word *plan*, the *–an* part is called the

    a) rhyme b) final phoneme c) rime d) morpheme e) onset

28. How many **morphemes** are in the word *gardener*?

    a) one b) two c) three d) four

29. How many **morphemes** are in the word *unbelievable*?

    a) one b) two c) three d) four

30. How many **morphemes** are in the word *pies*?

    a) one b) two c) three d) four

31. Each of the following words are considered to have an irregular component. Circle the grapheme whose pronunciation does not match the most frequent pronunciations of that particular grapheme.

1. busy 2. they 3. shoe 4. blood 5. laugh 6. both 7. brother 8. You

Short Answer: Please answer to the best of your ability.

32. List the **six syllable types** and an example of each (e.g., a single-syllable word exemplifying the particular syllable type, a multi-syllable word with the specified syllable type circled). As an example, the first has been listed for you (with any **one** of the labels considered correct); if you are able, please provide an example of this syllable type before moving onto the others.

Type	**Example**
a) Closed syllable, CVC, or VC	_____
b) _____	_____
c) _____	_____
d) _____	_____
e) _____	_____
f) _____	_____

Appendix 2

Real Word Spelling

1. accept: Please **accept** this gift.
2. make: In the morning I will **make** a sandwich.
3. frustrate: The number of car accidents each year **frustrate** the efforts of the organizations trying to prevent them.
4. pocket: My phone is in my **pocket**.
5. public: **Public** transport is fairly good.
6. message: I sent her a **message**.
7. thick: They walked through a **thick** forest.
8. thousand: Ten hundreds make a **thousand**.
9. nice: Today is a **nice** day.

10. ground: After the rain the **ground** is wet.
11. shock: The bad news came as a **shock**.
12. loud: The noise was extremely **loud**.
13. button: The **button** on my jacket came off.
14. thunder: The rain poured down and it started to **thunder**.
15. sudden: A **sudden** decision.
16. concentrate: I need to **concentrate** on passing this exam.
17. path: a garden **path**
18. sound: **sound** waves
19. attack: The town was under **attack**.
20. bucket: There is water in the **bucket**.
21. think: I need to **think** about this.
22. confuse: I often **confuse** the twins.
23. with: Please may I have coffee **with** milk.
24. outline: I will prepare a brief **outline** of the course.
25. hammer: Hit the nail with the **hammer**.

Appendix 3

Pseudo Word Spelling

plice, tround, conbencrate, fessage, thip, glound, crucket, conbuse, ousrine, dith, nath, annack, thint, acceft, cludden, thouvand, dake, thubler, frupthate, cammer, tutton, thricket, toud, shublic, slock

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