Science of Learning Principles That Support Learning to Read: How Are They Represented in Undergraduate Reading Course Textbooks and Syllabi?

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Abstract: *Improving children's reading proficiency is a need linked to teacher preparation programs. The Report of the National Reading Panel (NICHD, 2000) established five specific reading components related to developing proficient readers that undergird much of elementary/primary reading instruction. However, as reading assessments have progressed over the last 20 years, we continue to see the need to improve children's reading. Smagorinsky and Mayer (2014) stated that understanding how children learn to read fluently is part of the learning sciences. To develop proficient readers, pre-service teachers who become familiar with both the five specific reading components and the science of learning principles that contribute to children's reading proficiency may have more success in teaching children to read. Through this study, researchers examined the inclusion of the science of learning principles of modality, multimedia, self-explanation, organization, and feedback in upper-level elementary/primary teacher preparation program required reading courses in nine public Florida state university system institutions through analysis of required textbooks and course syllabi. Findings from this study indicated that the five science of learning principles were not explicitly represented; however, indirect representation of the five learning principles were found in textbooks and/or syllabi. Results from this study could be used by teacher preparation programs as a starting point to examine inclusion and expansion of these science*

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of learning principles ultimately to improve children's reading achievement.

Keywords: *teacher preparation, literacy/reading teacher education, elementary/primary teacher education, preservice teacher education, and science of learning*

1. Introduction

The Report of National Reading Panel (NICHD, 2000) cemented thinking about learning to read as including explicit instruction in five specific components considered as the science of reading: phonics, phonemic awareness, fluency, vocabulary, and comprehension. Following the Report of National Reading Panel and concerned with preparation of teachers, Walsh, Glaser, and Wilcox (2006) investigated the extent to which the five reading components appeared in undergraduate reading textbooks and syllabi; they reported that 15% of their sample provided minimal exposure.

More recently, Pomerance, Greenberg, and Walsh (2016) extended this line of research beyond the five components of reading to include cognitive principles that support developing reading proficiency: pairing graphics with words, linking abstract concepts to concrete images, deep questions and probing, alternating problems with solutions, distributive practice, and using assessment as instruction (Pomerance et al., 2016). Through an examination of textbooks for the instructional approaches aligned with cognitive science or science of learning principles, researchers concluded that none of the textbooks in their sample provided adequate descriptions of the aligned instructional approaches, although a few were mentioned (Pomerance et al., 2016).

Smagorinsky and Mayer (2014) voiced that "understanding how students learn to read fluently falls squarely within the domain of

the learning sciences" (p. 607). With this thinking in mind, we identified two science of learning principles that support children in developing early decoding and creating meaning from words : modality (presenting spoken text in contrast to written text only) and multimedia (presenting words and visuals simultaneously, rather than words alone) which have effect sizes of $d = 1.02$ and $d = 1.39$ respectively (Mayer, 2008). Also, we identified science of learning principles that foster children's development of comprehension: organization or mapping and outlining with an effect size of $d = .62$; self-explanation or creating a written or oral explanation with an effect size of $d = .61$; and feedback or giving learners information about their progress relative to the target, which has an effect size of $d = .73$ (Hattie, 2009).

Improving children's reading proficiency is a need that can be logically linked to teacher preparation globally. International and national assessments, such as the Progress in International Literacy Study (PIRLS) and the USA's National Assessment of Educational Program (NAEP), have found that children continue to lack targeted significant improvements in reading proficiency. On the 2016 PIRLS, 47% of fourth grade children tested reached the high benchmark and 10% reached the advanced benchmark (Mullis, Martin, Foy, & Hooper, 2017). NAEP (2017) results demonstrated that 36% of fourth grade children scored at or above proficient in reading. In the diverse, populous state of Florida, fourth grade test takers in 2017 did not improve appreciably the percent at or above proficient (41%), improving only by 2% from 2015 (39%).

The five components of reading were established at the turn of the 21st century, leading to enhancements in pre-service teachers' preparation to teach reading. Cognitive science presents teacher preparation programs with additional considerations for course enhancement that may lead to improved reading in elementary/primary schools. To develop more proficient readers, pre-service teachers need familiarity with not only the five components of reading, but also related cognitive science or science

of learning principles: thereby assuring that they know how to teach reading using cognitive science. Therefore, we aimed to explore the extent of inclusion of five science of learning principles in undergraduate elementary/primary reading courses. The overarching question researched was, "To what extent do textbooks and syllabi in undergraduate elementary/primary teacher education in the State University System (SUS) of Florida (USA) institutions' required reading courses include these science of learning principles: modality, multimedia, organization, self-explanation, and feedback?"

2. Literature Review

Mayer (2010) developed evidence-based principles of multimedia design based on Wittrock's (1974, 2010) generative learning theory. Specifically, Mayer focused on Wittrock's notion that 'meaningful learning depends on the learner's cognitive process during learning' (Mayer, 2010, p. 47). Attending to the cognitive processes in the science of learning, Mayer (2008) identified 10 evidence-based principles that increase "instructional effectiveness," that is, helping children learn (p. 763). Of the principles developed by Mayer, five of them align with how to help children learn to read: (a) modality, (b) multimedia, (c) organization, (d) self-explanation, and (e) feedback (Smagorinsky & Mayer, 2014). Each of these principles is explored briefly in the following sections.

2.1 Modality

Modality, an evidence-based principle focusing on managing essential processing, and helps children mediate the complexity of the material presented. Mayer (2008) defined complexity as "the number of elements and the relations between them" (p. 765). The modality principle requires that graphics (animation) be presented with spoken words rather than written text (Mayer, 2008). If graphics are presented with written text, the complexity of the

material presented increases, requiring children to attend to multiple stimuli through the visual channel, causing the visual channel to become overloaded. When applying the modality principle, children's visual and verbal channels are used simultaneously through graphics and spoken words, relieving the overload and reducing the complexity of the material (Mayer, 2008). In 17 experiments in which children were presented with either graphics and spoken text or graphics and written text, children who were presented with graphics and spoken words performed better on transfer tests (Mayer, 2008). The effect size of the modality principle was $d = 1.02$ in these experiments. Similarly, in a study presenting material on the Doppler effect with either a static, narrated presentation or with dynamic (animated), narrated presentations, students in the dynamic presentation groups performed better on transfer tests (Fiorella & Mayer, 2015).

2.2 Multimedia

Multimedia, an evidence-based principle focusing on fostering generative processing, which helps children integrate new material with existing knowledge. While modality focuses on pairing graphics with spoken text, the multimedia principle requires the pairing of written words or texts with pictures or other visuals related to those words or texts (Mayer, 2008). When learners are presented with both written words and associated pictures at the same time, deep learning takes place as learners make connections between the two (Mayer, 2008). In 11 experiments where students were presented with written text only or with written text and associated pictures, students who were presented with both words and pictures performed better on posttests (Mayer 2008). The median effect of the multimedia principle in these experiments was $d = 1.39$.

In a later multimedia principle study, Kennedy, Driver, Pullen, Ely, and Cole (2013) designed a podcast for pre-service teachers on phonological awareness. In the experiment, learners were presented

with a podcast that included both words and pictures, while others were presented with a practitioner journal article that contained only words. Learners who were in the podcast group outperformed the article-only group on both post-tests and maintenance probes (Kennedy et al., 2013).

2.3 Organization

While the modality and multimedia principles focus on the manner in which words and graphics are presented and later transfer to other situations, the organization principle focuses on how information is organized in graphical representations (Hattie, 2009). The graphical representations take the form of a concept map, knowledge map, or graphic organizer, which are most effective when used as a tool to summarize information transmitted in oral or written form (Hattie 2009; Fiorella & Mayer, 2016). Children, through the use of concept mapping, engage in deeper learning to synthesize and identify important concepts and the relationships among them. Concept mapping is particularly impactful for those who struggle with synthesizing and organizing concepts (Hattie, 2009).

Through various studies, researchers found empirical evidence to support the use of concept mapping as a tool to improve student achievement in elementary through post-secondary settings (Chiou, 2008; Ermis, 2008; Morfidi, Mikropoulous, & Rogdaki, 2018; Patchett & Garrett, 2008; Tajeddin & Tabatabaei, 2016). For example, in a study of grade 2, 4, and 5 children, graphic organizers were utilized with an experimental group to determine the effect on children's reading comprehension (Ermis, 2008). Analysis of post-test results demonstrated a statistically significant difference in mean scores, indicating a higher mean score for the group who utilized graphic organizers (Ermis, 2008).

In a similar study, struggling readers were exposed to digital text-based and multimedia concept maps or traditional lecture as

part of instruction when reading science informational texts (Morfidi et al., 2018). Students who participated in the concept mapping groups had higher mean scores on the cloze reading comprehension task post-assessment than those in the traditional lecture group. Researchers also found higher effect sizes for the concept mapping groups, ranging from $d = 0.68$ to $d = 0.87$ (Morfidi et al., 2018). Furthermore, concept maps help children when the information is presented orally. Patchett and Garrett (2008) found that kindergartners' reading comprehension improved through the use of graphic organizers, after teachers read orally to them.

2.4 Self-explanation

The self-explanation principle resides within the instructional meta-cognitive strategies (Hattie, 2009). Different from modality, multimedia, and organization, the self-explanation principle requires children to engage in a form of self-management of learning. Within this vein, self-management can take several forms, including self-instruction, self-evaluation, and self-monitoring (Hattie, 2009). Fiorella and Mayer (2016) define self-explanation as taking place when a child explains the contents of a lesson to himself or herself. For self-explanation to be effective, children must be able to identify the most important information from the lesson, make inferences to create a schema, and integrate new knowledge with existing knowledge (Fiorella & Mayer, 2016).

Although the self-explanation principle has been studied primarily in relation to mathematics and science instruction (Fiorella & Mayer, 2016; Matthews & Rittle-Johnson, 2009; McEldoon, Durkin, & Rittle-Johnson, 2013), there is research supporting its use to improve reading comprehension (Griffin, Wiley, & Thiede 2008; Jozwik, Cuenca-Carlino, Mustian, & Douglas, 2019). For instance, in a study of college psychology students, students read informational texts and were asked to provide self-explanations as they read (Griffin et al., 2008). Findings from the study indicated that self-explanation led to greater monitoring accuracy during

reading for all participants, including high-ability readers (Griffin et al., 2008).

Moreover, fifth grade English learners with learning disabilities were found to have enhanced learning when using self-explanation (Jozwik et al., 2019). Specifically, when children were taught to apply strategies, such as thinking out loud, asking questions of the text, and making text connections, they demonstrated a higher ability to comprehend the text and answer text-dependent questions (Jozwik et al., 2019).

2.5 Feedback

Feedback, the last principle discussed in this framework, is defined as information "provided by an agent regarding aspect's one's performance or understanding" (Hattie & Timperley, 2007, p. 87). For feedback to be effective, it can be conceptualized as hinging on three questions: (a) where am I going? (b) how am I going? and (c) where to next? (Hattie & Timperley, 2007; Hattie 2009). Additionally, Hattie and Timperley (2007) emphasized that feedback must occur after instruction has been delivered. The purpose of feedback within this context is "to reduce the discrepancy between current understanding and desired understanding" (Hattie &Timperley, 2007, p. 86). It is important to note that feedback as conceptualized by Hattie and Timperley (2007) is an iterative process between the teacher and the student. Specifically, Hattie (2009) states that when teachers collect information through feedback "as to what students know, what they understand, where they make errors, when they have misconceptions, when they are not engaged—then teaching and learning can be synchronized and powerful" (p. 173).

Several studies demonstrated the importance of feedback in improving student outcomes in reading (Nicholas & Paatsch, 2014; Schünemann, Spörer, Völlinger, & Brunstein, 2017; Stevens, Walker, & Vaughn, 2017). For example, in a review of the literature

of fluency interventions for students with disabilities, Stevens and colleagues (2017) found that error correction feedback led to improved reading fluency for students. Feedback was most effective when it was coupled with re-readings of the text.

Effects of individualized feedback through student conferencing on the phonemic awareness of children in Australia were examined by Nicholas and Paatsch (2014). During the conference the teacher provided individualized, specific feedback on identifying letters and sounds followed by goal-setting with the child for future conferences (Nicholas & Paatsch, 2014). Children who participated in the feedback through student conferencing group mastered all letters and sounds by the last term of the school year, whereas other groups did not (Nicholas & Paatsch, 2014).

3. Methodology and Data

For the present study, we utilized a qualitative methodology to investigate the extent to which the five selected science of learning principles (i.e., modality, multimedia, organization, self-explanation, and feedback) were represented in undergraduate elementary/primary education required reading courses in the State University System (SUS) of Florida institutions. Based on grounded theory research, a document analysis was utilized to collect and record data (Glaser & Strauss, 2008). We independently examined archival documents in the form of required course textbooks and syllabi identified for required upper-level undergraduate elementary/primary reading courses for the presence of the five selected science of learning principles.

We selected course textbooks and syllabi for the document analysis because they represent the course learning intentions of faculty. Specifically, these documents outline course scope and content, assignments and learning activities, and the intended learning outcomes. Moreover, the syllabi align with course descriptions within SUS of Florida institutions' undergraduate

catalogs. The examination of textbooks and syllabi also ensured triangulation of data for qualitative analysis to be valid and rigorous (Cresswell, 2003).

The State University System (SUS) of Florida was comprised of 12 institutions identified as the study population. To determine the sample, we used the RED course prefix to identify required upper-level undergraduate elementary reading courses, the prefix established by the Florida Department of Education Statewide Course Numbering System. Two institutions did not have an undergraduate elementary/primary education program and one institution with an undergraduate elementary/primary education program did not require a course with the RED prefix, resulting in a final sample of nine SUS of Florida institutions. Due to the variation in the number of sections of required reading courses in institutions and for consistency, the first section of the first two required courses for each institution was included in the sample for analysis.

3.1 Data collection phases

Phase one

Data collection was separated into three different phases. The first phase was to identify the required reading courses from the sample of nine SUS of Florida institutions. Each institution's online course guide for the fall 2018 semester was accessed to identify two required RED courses in undergraduate elementary/primary education programs. The first two upper-level required reading courses were selected for analysis, resulting in 18 total reading courses.

Phase two

The second phase of data collection was to identify and collect the textbooks required in the 18 required reading courses across the 9 institutions. Institutions' online bookstores were utilized to compile a list of required textbooks. Twenty-six different required

textbooks were identified for the 18 required reading courses. Data were collected from an examination of the table of contents through online availability. If a textbook's table of contents was not available online, a copy of the textbook was purchased and examined. Rationale for examining the table of contents is that authors' major foci are presented in this feature.

Phase three

The third phase was to collect syllabi for the 18 required reading courses. We emailed the undergraduate elementary education program coordinator of each institution included in the sample and requested a copy of the syllabus for each of the selected reading courses from the fall 2018 semester. Our requests yielded syllabi for both reading courses from 6 institutions, resulting in a total of 12 syllabi. Syllabi from the remaining three institutions were not provided and, therefore, not included in the analysis.

3.2 Instrumentation

Data collected from the examination of reading course textbooks and syllabi were recorded on the Scoring Matrix for State University System (SUS) of Florida Institutions©, an instrument created and piloted by us (see Appendix A). A scoring system was utilized to record the presence of the five selected science of learning principles (e.g., modality, multimedia, self-explanation, organization, and feedback) as either explicitly stated (5 points), indirectly stated (3 points), or not present (0 points). To maintain the anonymity of each institution, the names of the SUS of Florida institutions were randomized and assigned an alpha-numeric code. Therefore, each institution is referred to as SUS with a numeric code (e.g., SUS 1). Once data collection was completed, we quantified the evidence utilizing the scoring matrix. Textbooks and syllabi were scored separately and recorded on the matrix of the individual institutions. Each SUS of Florida institution had the possibility of acquiring 100 total points in the examination of textbooks and syllabi; 50 total points for textbooks and 50 total points for syllabi for the presence

of the five science of learning principles. In this section, we explain the process used to score the textbooks and syllabi.

Textbook and syllabi scoring

Table of contents of each individual textbook was examined on three different occasions for the language found in the literature that represented the science of learning principles in this study. Each reading course textbook's table of contents was examined first for explicit representation, then related indirect language. If neither were found, then it was determined there was no presence of the five learning principles.

If a learning principle was found to be explicitly labeled (e.g., modality, multimedia, self-explanation, organization, or feedback) the evidence was recorded and a score of 5 points was assigned to that reading course for the presence of that learning principle. If a learning principle was not explicitly labeled, we examined the textbook's table of contents to find evidence of indirectly stated principles. We quantified indirectly stated principles as those that utilized representational language from the literature. For example, for the organization principle, textbooks were examined for phrases such as graphic organizers or semantic mapping. Indirect evidence was recorded in the same matrix and a score of 3 points was assigned for the presence of that learning principle. If no evidence was found, nothing was recorded in the matrix and a score of 0 points was assigned.

In the analysis of evidence collected from reading course syllabi, the same scoring method was utilized as with the textbook examination. Syllabi from 12 reading courses' first section were examined in its entirety including, but not limited to: course description, objectives, requirements, and schedule of topics. Utilizing the same themes of representational language as in the analysis of textbooks, a direct statement of a learning principle was assigned a score of five points; indirect representations of a learning

principle were assigned a score of three points; and no evidence assigned zero points.

4. Findings

A total of 26 unique required textbooks for the sample's 18 courses were included in the analysis. The copyright dates of the required textbooks ranged from 2006 to 2018. Of the required textbooks, the ones most commonly required were (in descending order): Honig and Gutlohn (2012), Bear, Invernizzi, Templeton, and Johnston (2015), Beck and Beck (2013), Cunningham and Allington (2015), Tompkins (2013), and Vacca, Vacca, and Mraz (2013). Table 1 displays the 26 textbooks from the 18 required reading courses including the author(s), copyright year, and frequency required.

Table 1. Twenty-six Required Reading Courses in Nine SUS Institutions' Sample: Textbook Author(s), Year, and Frequency

Authors(s)	Year	(*f*)
Bear, D. R., Invernizzi, M., Templeton, S., & Johnston, F.	2015	3
Beck, I. L. & Beck, M. E.	2013	3
Blevins, W.	2006	1
Buel, D.	2017	1
Calkins, L., Ehrenworth, M., & Lehman, C.	2012	1
Cornett, C.	2009	1
Cunningham, P. M., & Allington, R. L.	2015	3
DeVries, B.	2014	1
Fisher, D., Brozo, W.G., Frey, N., & Ivey, G.	2014	1
Ganske, K.	2008	1
Ganske, K.	2013	1
Ganske, K.	2018	1
Govoni, J. M.	2018	1
Harvey, S., & Goudvis, A.	2017	1
Honig, B., Diamond, L., & Gutlohn, L.	2012	5
Johns, J., Johns, B., & Elish-Piper, L.	2016	1
Johnston, P. H.	2004	1
Leslie, L., & Schudt Caldwell, J.	2016	1
McLaughlin, M.	2009	1
National Institute for Literacy.	2013	1
Nessel, D. D., & Dixon, C. N.	2008	1
Reutzel, D. R., & Cooter, R. B.	2012	1
Temple, C. A., Ogle, D., Crawford, A. N., & Freppon, P.	2017	1
Tompkins, G.E.	2013	2
Tompkins, G. E.	2014	1
Vacca, R. T., Vacca, J. L., & Mraz, M.	2013	2

Note. See References for full citation for each text. Source: Camara, 2019, p. 89

4.1 Course textbooks: explicit and indirect representation

Of the 5 science of learning principles identified in this study as important for teachers to use in developing proficient readers, 3 were found to be explicitly represented in tables of contents for 4 out of the 18 reading courses investigated: modality, organization, and feedback. The textbook by Vacca, Vacca, and Mraz (2013), used in three reading courses, explicitly noted the inclusion of the

modality and organization principles in the table of contents. The textbook by Cornett (2009) explicitly noted the feedback principle and was required in one reading course.

The organization, multimedia, and self-explanation learning principles were found to be indirectly stated in the table of contents of textbooks utilized in the sample of required reading courses. Indirect representation included terms referencing graphic organizers (organization), dual representation in words and visuals (multimedia), and learners verbalizing meaning (self-explanation; Fiorella & Mayer, 2016; Mayer, 2008). The organization principle was found to be indirectly stated in at least one required textbook table of contents of 14 out of 18 total required courses. Accepted terms for organization principle and texts in which they were found included: "KWL charts" (Tompkins, 2013), "semantic mapping" (Vacca et al., 2013), "sematic map" (Honig et al., 2012; Reutzel, & Cooter, 2012), "compare and contrast bubbles" (Cunningham & Allington, 2015), "graphic and semantic organizers" (National Institute for Literacy, 2013), and "graphic organizer" (Temple et al., 2017).

The multimedia principle was found indirectly stated in a textbook utilized in 4 of the 18 total required reading courses, while the self-explanation principal was utilized in 6 of the 18 total required reading courses. Accepted phrases for the multimedia principle were: "helps students understand diagrams and graphics in informational texts" (DeVries, 2014), "adjunct displays" (Fisher et al., 2014), and "visual and graphic information" (Temple et al., 2017). "Think aloud" was accepted and found in Tompkins (2013) as an indirect statement of the self-explanation principle.

4.2 Course textbooks: SUS institution scores

Based on the analysis, none of the institutions were found to have explicit representation of the five learning principles. The greatest representation was two explicitly-labeled learning

principles in a textbook of a reading course in three institutions. One of the learning principles was labeled explicitly in one textbook of one reading course in the remaining six institutions. Out of the 50 possible points, the highest score was 19 and the lowest was 6, resulting in a range of 13 and mean of 11.9. Table 2 displays the nine SUS of Florida institutions in rank order based on the overall institution score for textbooks and points acquired for each learning principle.

Table 2. Rank by Score for Presence of Science of Learning Principles in Nine State University System (SUS) of Florida Institutions' Sample: Required Reading Course Textbooks

		Science of Learning Principle Score				
Rank	SUS Score	Modality	Multimedia	Organization	Self-Explanation	Feedback
1	19	5	3	8	3	0
2	16	5	0	8	3	0
2	16	5	0	8	3	0
3	12	0	3	6	3	0
3	12	0	3	6	3	0
4	11	0	0	6	0	5
5	9	0	3	3	3	0
6	6	0	0	6	0	0
6	6	0	0	6	0	0
Learning Principle Total Score		15	12	57	18	5

Note. 10 points possible for each principle for a total possible of 50 points
Adapted from: Camara, 2019, p. 109.

4.3 Syllabi: direct and indirect representation

After three examinations of the 12 syllabi from the 6 courses, no direct representation of the selected science of learning principles was found. In subsequent examination of course syllabi, only indirect representation of the five science of learning principles was found. The science of learning principles of organization, modality, and multimedia were represented indirectly in four syllabi, one course each from four separate institutions. These institutions had the same score of three since only one principle was identified in one course syllabi each. Two institutions had no indirect representation of the five learning principles.

Three principles were found to be included with indirect representation. The organization principle had indirect representation in a reading course syllabus of SUS 1 due to the language "graphic organizers" and a reading course syllabus of SUS 7 due to the language of "semantic map." The modality principle had indirect representation in one reading course syllabus of SUS 8 with the term "multisensory instruction," representing that people learn better from graphics with spoken text rather than graphics with printed text, using more than one sense (Mayer, 2008). The multimedia principle was indirectly represented in the syllabus of one reading course for SUS 4 with the phrase "employ different resources, i.e., words and images."

5. Discussion

5.1 Course textbooks and representation of the five learning principles

We found that none of the nine State University System (SUS) of Florida institutions in the sample had all five selected science of learning principles explicitly represented in textbook table of contents of their undergraduate elementary/primary education

required reading courses. The results of this study indicated the five science of learning principles had minimal textbook presence, given that they did not have enough presence to be in the table of contents. Encouraging was that three institutions were found to have two out of the five learning principles explicitly represented in at least one textbook of one required reading course. Also, six institutions were found to have one learning principle explicitly represented in at least one textbook of one reading course.

Given the emphasis on children's assessments that measure high-level and complex thinking, it is important for university instructors to consider the inclusion of these and other principles as they select course texts. Moreover, due to the current era of high accountability for teacher preparation programs and success of program completers, the same emphasis on high-level and complex thinking approaches, as represented by the science of learning principles, may be a consideration for textbook authors as they engage in developing future textbooks and revisions.

In the examination of textbooks, modality and organization learning principles were the most frequently addressed principles with explicit representation in at least one textbook in 3 out of 18 reading courses. Although most frequently noted, there was lack of presence in the remaining reading course textbooks examined. Further, it was found that the multimedia and self-explanation principles were the least frequently addressed principles with no explicit representation found in the reading course textbook sample. These findings are particularly important as children are learning to read in classrooms with not only print, but also digital resources, that should reflect these learning principles in instructional design of materials by teachers and others. Understanding these principles to the extent that they are recognized and valued by pre-service teachers may assist them in developing proficient readers once they are in teaching positions.

There was also a lack of emphasis placed on feedback as a learning principle in the textbooks' table of contents. According to Hattie (2009) who explored meta-analyses of 134 studies, feedback was found to be one of the most "powerful influences on achievement" (p. 173). In the current study, feedback was found to be the least frequently addressed learning principle and only indirectly represented in one reading course textbook table of contents which was utilized in one of the 18 courses investigated.

When viewing these findings from an institutional perspective, we found that of the nine SUS institutions' required reading courses one addressed four learning principles; five addressed three learning principles; one addressed two learning principles; and two addressed only one of the learning principles. In similar studies in which researchers investigated textbooks for science of learning principles, minimal representation in any one textbook was identified (Joshi et al., 2009; Pomerance et al., 2016).

If the required reading course textbooks are one of the main sources of information for undergraduate students, then the lack of representation may negatively influence reading instruction effectiveness once completers have the responsibility of developing young readers. If the science of learning principles are important in the teaching reading, an opportunity for meaningful revision of textbook selections, development of new textbooks, or revisions of future editions exists. When selecting textbooks for elementary/primary education reading, instructors may consider include contemporary textbooks that reflect heightened emphasis on the science of learning principles that teachers can use to improve children's reading proficiency.

5.2 Course syllabi and representation of the five learning principles

Course syllabi were also examined for the inclusion of science of learning principles and had less of a presence than in the reading

courses' textbooks. None of the six institutions for which syllabi were examined were found to have explicit representation of the five selected science of learning principles. Four of the institutions reflected indirect representation of the presence of one learning principle each. Two of the six institutions had no presence of the selected learning principles in their two reading course syllabi. Aligned with the finding related to course textbooks' table of contents examined, feedback was the least frequently represented learning principle with no presence in the sample of reading course syllabi examined. Science of learning principle scores for syllabi from the six institutions are presented in Table 3.

Table 3. Scores of Science of Learning Principles in Six State University System (SUS) of Florida Institutions' Sample: Required Reading Course Syllabi

		Science of Learning Principle Score				
SUS	Score	Modality	Multimedia	Organization	Self-Explanation	Feedback
1	3	0	0	3	0	0
4	3	0	3	0	0	0
7	3	0	0	3	0	0
8	3	3	0	0	0	0
3	0	0	0	0	0	0
5	0	0	0	0	0	0
Learning Principle Total Score		3	3	9	0	0

Note. 10 points possible for each principle for a SUS total possible of 50 points. Syllabi were not collected for SUS 2, SUS 6 and SUS 9 and not included in the table. Source: Camara, 2019, p. 115.

5.3 SUS of Florida institutions and representation of the five learning principles

Each SUS of Florida institution could acquire 100 points for a total SUS score with the explicit representation of the five science of learning principles in at least one textbook's table of contents and course syllabi for two required reading courses. As a reminder, of the 9 SUS institutions investigated, 18 reading courses' textbooks and 12 reading courses' syllabi were examined for explicit representation.

Of the 12 reading courses investigated for presence of the learning principles in both textbooks and syllabi, SUS 1 acquired the most points for a total of 19 out of 100. SUS 5 acquired the least for a total of 6 out of 100 points. Besides the low score of the sample courses and institutions, other data raise questions. When reviewing Table 5, you may note that some institutions had textbooks with learning principles, but the associated syllabi did not have similar representations. These discrepancies may indicate lack of alignment of textbooks and syllabi, lack of detail in the syllabi, or may indicate that even with presence in a required textbook that the principle may not be a core instructional consideration. Rank by total score along with summary of science of learning principle scores for textbooks and syllabi are presented in Table 4.

Table 4. Rank Order of Nine State University System (SUS) of Florida Institutions' Required Reading Courses: Inclusion of Science of Learning Principles

Rank	SUS	Institution Total Points (100 points possible)	Textbooks Total Points (50 points possible)	Syllabi Total Points (50 points possible)
1	1	19	16	3
1	2	19	19	-
2	7	14	11	3
3	8	12	9	3
4	3	11	11	0
5	4	9	6	3
5	9	9	9	-
6	5	6	6	0
7	6	3	3	-

Note. A dash (-) indicates a syllabus was not collected. Source: Camara, 2019, p. 117.

6. Conclusion

We limited this initial study to particular courses in one state's university teacher preparation programs in the USA and understand that findings in other locations and around the world may differ. The findings are not intended to reflect the quality of the SUS institutions' undergraduate elementary/primary education reading courses nor of the undergraduate programs. Instead, we present the findings as a starting point to begin greater inclusion in elementary/primary education reading instruction courses of the selected science of learning principles to develop more effective reading teachers to improve children's reading.

Furthermore, results of this study on the presence of selected science of learning principles may be used as considerations for strengthening syllabi and in selecting textbooks used as resources, in addition to creating new textbooks and next editions of the textbooks. If syllabi are not complete to represent accuracy in the inclusion of science of learning principles, then it may be important for syllabi to have enough detail to accurately represent the expectations for student learning within each course. Additionally, requiring textbook editions that are recently published with science of learning principles noted in table of contents, and, therefore, considered important to the author may be a consideration for continuous improvement of elementary/primary education program completers' children's reading.

Preparation of pre-service teachers to develop proficient readers is important to improving the reading achievement of children. Factors that influence the preparation include required textbooks and course syllabi (Pomerance et al., 2016). Future researchers who choose to explore this topic further may consider including supplemental resources, instruction, and the full spectrum of undergraduate elementary education courses within the scope of their research. Additionally, they may consider other research designs (e.g., surveys, interviews, etc.) to collect evidence of the presence of the five learning principles in undergraduate reading courses.

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Appendix A
SCORING MATRIX FOR STATE UNIVERSITY SYSTEM (SUS) OF FLORIDA INSTITUTIONS

SUS of Florida Institution		Science of Learning Principle					Course Score
		Modality	Multimedia	Organization	Self-Explanation	Feedback	
Reading Course 1	Textbook						
	Syllabus						
Reading Course 2	Textbook						
	Syllabus						
Total Points							Institution Score:

Criteria and Possible Points: Labeled explicitly (5 points), indirectly stated (3 points), and not present (0 points) Source: Camara, 2019, p. 138.