Emergent Bilinguals and Multimedia Instructional Design: Applying the Science of Learning Principles to Dual Language Instruction

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The purpose of this practice to theory article is to present educational leaders with critical considerations for multimedia instructional content for emergent bilinguals (EBs) in dual language programs and other EB academic settings. EBs' academic development and achievement are advanced when multimedia instruction is intentionally designed to address language inputs and science of learning principles for multimedia instruction. Instructional leadership practices for emergent bilinguals may benefit from an understanding of the connection between the science of learning principles for multimedia design and second language learning. This article begins with a brief discussion of EB instructional leadership and continues with an overview of language inputs and dual language instruction. Next, it introduces the cognitive theory of multimedia learning and science of learning principles focused on for this discussion. The article concludes with an example of the science of learning principles applied to a second language lesson and considerations for EB multimedia instruction design as educational leaders provide EB instructional leadership in schools and school districts.

Keywords: dual language instruction, emergent bilinguals, English learners, instructional leadership, multimedia instruction, science of learning

Emergent bilinguals' academic development and advancement is supported through instructional programs and strategies that build on their linguistic assets and promote deeper learning. Although the term emergent bilingual (EB; Garcia & Wei, 2014) could refer to any student who is developing proficiency in two languages, its most common use signifies what the US Department of Education calls English learners, which are students who are in the process of acquiring a level of English proficiency that enables grade-level academic achievement, and who speak a different first language. Dual language programs, designed to develop bilingualism, have proven beneficial in furthering EBs' academic achievement. Likewise, the use of evidence-based instructional design models also facilitate EBs' teaching and learning. While there are several instructional design models, we focus on multimedia instructional design principles drawn from the cognitive theory of multimedia learning (CTML; Mayer, 2014). We chose CTML because instructional content in dual language classrooms (and other second language learning settings) includes multimedia instructional messages (Mayer, 2014) to facilitate second language learning. Using Mayer's (2008, 2014) definition, multimedia instructional messages in dual language classrooms refer to instruction that uses both words and pictures (multimedia) to promote second language learning and academic content learning (instructional message*)*.

As is known, principals and other educational leaders who focus their efforts on instructional leadership practices have a greater influence on student achievement outcomes (Hattie, 2009). Possessing research- and theory-based knowledge of EB instruction and leading teachers in deepening their own knowledge to inform EB instruction has been associated with positive EB student outcomes (DeMatthews & Izquierdo, 2018; Theoharis & O'Toole, 2011; Wiemelt & Welton, 2015). To strengthen teaching and learning in dual language programs, specifically, and in second language learning settings generally, it is advantageous for educational leaders tasked with supporting EBs' academic development to understand the science of learning principles informing the design of multimedia instruction to ensure EBs are presented with intentionally-designed instructional content that results in deeper learning. We begin our discussion by establishing the connection between EB instructional leadership practices and EB academic outcomes by providing a brief overview of EB instructional leadership. Then, we provide background on dual language instruction and instructional inputs for second language learning. Next, we present a brief discussion of CTML and its relationship to cognitive load theory, followed by the SOL principles we focus on for this discussion. We conclude with examples of instructional content designed using SOL principles and implications for EB instructional leadership practices.

Instructional Leadership for Emergent Bilinguals

Traditionally an underserved group, EBs experience reduced academic outcomes and opportunities when compared to non-EBs (Gándara & Mordechay, 2017). To shift this academic narrative, researchers analyzed leadership practices impacting EB success, particularly those related to school leaders' EB instructional leadership (Clark & Chrispeels, 2022; Theoharis & O'Toole, 2011; DeMatthews & Izquierdo, 2020; Scanlan & López, 2012). Findings suggested that EB instructional leadership includes possessing curricular and instructional knowledge and having the ability to engage in data analysis related to EBs (Clark & Chrispeels, 2022). A salient aspect of EB instructional leadership is teachers' perception of principals' ability to support them in

developing their EB instructional expertise and guiding the work of professional learning communities (Clark & Chrispeels, 2022). For example, in a case study of a principal's EB instructional leadership practices, DeMatthews and Izquierdo (2020) found that principal supports in developing teachers' EB instructional expertise included conducting classroom observations, engaging in data analysis with teachers, participating in lesson planning, providing professional learning, and individualizing further supports based on teachers' specific needs.

To support EB teaching and learning effectively as the literature suggests, educational leaders benefit from deeper understandings of EB pedagogy and second language acquisition models as they lead in schools (Scanlan & López, 2012). The literature highlights features of educational leadership preparation programs that engage aspiring educational leaders in analysis of EB-related issues in schools (Trujillo & Cooper, 2014). It is unclear, however, the extent to which educational leaders have opportunities to develop EB pedagogical expertise prior to entering a leadership position. Therefore, continued development of educational leaders' EB pedagogical expertise is critical as Vera and colleagues (2022) uncovered. Through an EB professional learning needs assessment administered to teachers and educational leaders, Vera et al. found that educational leaders perceived various EB professional learning needs, including the use of evidence-based EB instructional strategies and materials. Following the needs assessment, professional learning was provided where EB instructional strategies were integrated and modeled throughout the sessions (Vera et al., 2022). Participants indicated that the professional learning was beneficial in helping them to foster "interactive, language-rich learning environments" (Vera et al., 2022, p. 104).

Dual Language Instruction

As noted by Scanlan and López (2012), educational leaders promote positive EB outcomes as they select and implement second language acquisition models and advance linguistically responsive teaching in schools. Longitudinal research conducted by Collier and Thomas (2017) has shown that all student groups enrolled in dual language programs achieve at higher levels on state and national assessments than their peers in other program types. EBs, in particular, benefit from dual language instruction, as evidenced by longitudinal achievement gap closure data that show the substantial difference between EB and non-EB performance in third grade is eliminated by seventh grade, with EBs reaching grade-level achievement (Thomas & Collier, 2012).

In addition to promoting higher academic achievement on state and national tests, dual language programs offer the valuable benefit of developing bilingualism and biliteracy. Collier and Thomas (2017) noted that proficient bilinguals have higher creativity, problem solving, metalinguistic awareness, and executive function skills, among other attributes. Dual language programs are a type of bilingual education that uses two languages for instruction, English and a partner language. Some dual language models, known as Developmental Bilingual Education (Hamayan et al., 2013), are designed primarily for emergent bilinguals to develop their home language proficiency while developing proficiency in English. Other models, known as Two-Way Immersion, enroll students who are proficient in English and not in the partner language as well as emergent bilinguals who are proficient in the partner language and are acquiring English as a new language. These two-way models typically divide instructional time into varying proportions of English and the partner language, with 50/50 being a common distribution for all grade levels.

Other models gradually reach the 50/50 split, beginning with 90 percent partner language and 10 percent English in kindergarten, 80/20 in first, 70/30 in second, 60/40 in third, and 50/50 in fourth and beyond (Hamayan et al., 2013). We will now look more closely at dual language program classroom practices that support EB achievement, examining the role of instructional input and the SOL principles that can inform its use.

Instructional Input

Instructional materials can be viewed as a type of input according to second language acquisition theory. The role of input has been studied for decades and has been determined to be an important factor in learning a second language (Ellis, 2008). More specifically, noted scholar Stephen Krashen (1985) posited that second language input must be comprehensible to be learned. When EBs are exposed to words, phrases, or sentences that use language they are not familiar with, the language must be accompanied by extralinguistic cues such as images, real objects, and movement/gestures (multimedia) to convey the meaning, which makes the unfamiliar language comprehensible, and hence, learnable.

Input is one of three elements that are necessary for learning second languages. Interaction between emergent bilinguals, and between emergent bilinguals and proficient speakers, has been a major subject of current research (Mitchell et al., 2019), and the linguistic output that learners produce has been shown to be crucial for developing proficiency (Swain, 2005). Nonetheless, input continues to be a recognized element known to be necessary for acquiring a second language and thus merits continued examination and application in the field. Clearly, multimedia instruction can provide these essential extralinguistic cues more readily than printed text alone. To be effective, however, careful attention needs to be given to the design of multimedia instruction so that it attends to cognitive load theory, which informs how learners process new knowledge.

Cognitive Theory of Multimedia Learning and the Science of Learning Principles

As learners acquire new knowledge and transfer it to long-term memory, they experience cognitive loads due to limits on working memory and amounts of information that can be processed (see Sweller, 2020; Sweller et al., 2019). To facilitate learning, cognitive loads can be managed through instructional designs that reduce non-essential information or tasks (i.e., extraneous load) and support "cognitive structures and processes" related to the intended learning (i.e., germane load; Van Merriënboer et al., 2006, p. 344). Mayer's (2014) cognitive theory of multimedia learning (CTML) addresses cognitive loads by considering the role of working memory and long-term memory in the processing of multimedia instructional messages. CTML posits that to process information, learners use two channels (i.e., visual/pictorial and verbal/auditory) with both channels limited in their processing capacity (Mayer, 2014). To gain new knowledge efficiently from multimedia instruction, a distinct set of processes must take place as information is acquired through the two channels, processed through working memory, combined with prior knowledge from long-term memory, and added to long-term memory for later retrieval (Mayer, 2008, Figure 2). The processes support learners by (a) reducing extraneous

processing, (b) managing essential processing, and (c) fostering generative processing (Mayer, 2008).

By reducing extraneous processing in the instructional design process, learners are able to use their cognitive capacity to focus on essential new information to construct a "cognitive representation" (Mayer, 2008, p. 763). When managing essential processing is applied, learners are supported as they process complex information to build a cognitive representation (Mayer, 2008). To foster generative processing, learners must utilize their cognitive capacity to interpret information presented to create cognitive representations (Mayer, 2008, 2017).

To engage in these processes to facilitate and deepen learning, Mayer (2008) outlined ten evidence-based science of learning principles (SOL) that should be incorporated into the multimedia instructional design. Of the ten SOL principles, we focus on six because they directly support EBs' second language learning. Reducing EBs' extraneous processing, managing EBs' essential processing, and fostering EBs' generative processing are particularly relevant to dual language instruction because EBs are developing oral language proficiency and literacy in a language through which they are also learning new content. In the sections that follow, we describe the SOL principles we focus on for this discussion.

Coherence, Signaling, Spatial Contiguity, and Temporal Contiguity Principles

Coherence, signaling, spatial contiguity, and temporal contiguity are SOL principles intended to reduce extraneous processing (Mayer, 2008). For new information presented to be *coherent*, extraneous information should be eliminated or reduced (Mayer, 2008). In other words, instructional content should be designed so that it includes only essential information aligned to the learning intention. Schweppe and Rummer (2014) argued that non-essential, high interest information or what they termed as the "seductive details effect" (p. 298), interferes with learners' capacity to process information, particularly for learners with less prior knowledge. Therefore, when the coherence principle is not applied, learners have difficulty distinguishing between essential and non-essential information. In a study on the coherence principle, Jiang et al. (2017) analyzed teacher and student perceptions of the prevalence of the coherence principle in English as a foreign language (EFL) coursework. The researchers found that students perceived that the coherence principle was not fully addressed, and that the reduced coherence detracted from their learning. Teachers, on the other hand, perceived that the coherence principle was present in EFL coursework (Jiang et al., 2017), pointing to a mismatch in perceptions of coursework design.

While coherence focuses on reducing non-essential information, the *signaling* principle underscores the importance of highlighting important information for learners (Mayer, 2008). Signaling critical information can occur through labeling, color coding, or by providing summary information to communicate essential information to the learner. Studies on the signaling principle revealed increased learning outcomes for learners provided with multimedia that incorporated signaling (i.e., illustrations with labeled text) when compared to learners provided with multimedia that did not apply the signaling principle (Jian, 2019; Lin et al., 2017; Mason et al., 2013). Findings indicated that when the signaling principle was present, learners spent time reading labeled text and studying the illustrations (Mason et al., 2013), resulting in improved learning outcomes.

In addition to signaling, spatial contiguity is also necessary to reduce extraneous processing. The spatial contiguity principle refers to the placement of printed words next to pictures or graphics (Mayer, 2008). When pictures or graphics are presented, corresponding text should be integrated (i.e., in close proximity) with the pictures or graphics instead of separated (i.e., placed far from) pictures or graphics (Mayer, 2017). Schroeder and Cenkci's (2018) meta-analysis of 36 studies found that instructional designs with spatial contiguity increased learning outcomes. Further, individual studies found that integrated examples using spatial contiguity supported learning outcomes in mathematics lessons (Tindall-Ford et al., 2015) and science lessons (Schlag & Ploetzner, 2011). In a study of learners' perception of Japanese language learning and spatial contiguity, participants indicated that the placement of corresponding words and pictures facilitated their learning because spatial contiguity led to quicker comprehension of written text (Ayub et al., 2017).

Finally, the temporal contiguity principle refers to concurrent narration and animation. Spoken words related to pictures, graphics, or animation presented should be presented simultaneously rather than presented separately (Mayer, 2008). In a study on temporal contiguity and split-attention effects on learning a computer programming language, findings suggested that the simultaneous presentation of lecture notes, a worked example, and explanations from the instructor facilitated learners' understanding of the programming language based on the results of pre- and post-tests (Chang et al., 2011). Focusing on temporal contiguity, but with an emphasis on student perceptions using a cognitive load pre- and post-test, Cheng et al. (2015) found that students who received instruction attending to temporal contiguity reported a lower perception of cognitive load. In terms of learners' affect, Park (2015) found that presenting spoken words coupled with an image contributed to learners' self-perceptions of confidence (i.e., belief that one could be successful in learning) and relevance (i.e., belief that one's needs as a learner are met), which strengthened learners' motivation.

Pretraining Principle

Pretraining supports learners in managing essential processing (Mayer, 2008), particularly when the essential information presented is so complex that it may overload learners' cognitive capacity (Mayer, 2017). The pretraining principle sets forth that learners should be presented with background information on the upcoming lesson (i.e., vocabulary, concepts, etc.) because learners acquire complex information more readily when they have prior knowledge (Mayer, 2008, 2017). In short, for deep learning to occur learners must be able to make connections between new information being presented and their prior knowledge (Mayer, 2008; Wittrock, 1974, 2010).

Because prior knowledge is critical to learning, it is necessary for learners to "receive pretraining that activates or provides relevant prior knowledge" (Moreno & Mayer, 2007, p. 320). Pretraining is particularly impactful for learners who possess minimal or no knowledge on the topic presented (Renkl et al., 2009). Studies on the learning effects of the pretraining principle demonstrated increased learning outcomes (Bos et al., 2009; Gegner et al., 2009; Kennedy et al., 2014). For instance, Gegner et al. (2009) found that use of the pretraining principle supported learners' comprehension of scientific text and promoted "positive beliefs" related to reading scientific text (p. 94). Bos et al. (2009) also found that pretraining supported increased learning

outcomes when coupled with a pre-test, presentation of information, opportunities for learners to ask questions, and provision of feedback.

Multimedia Principle

Multimedia fosters generative processing, where learners use their cognitive capacity to create cognitive representation, resulting in deeper learning (Mayer, 2008, 2017). Presenting learners with both words and pictures instead of only words supports increased learning outcomes (Mayer, 2008). To support deeper learning, graphics or pictures utilized should be instructionally relevant to the learning at hand and not simply high interest (Sung & Mayer, 2012). Studies on the multimedia principle have demonstrated improved learning outcomes in post-tests for learners (Frumusela et al., 2015; Issa et al., 2013). For example, Herrlinger et al. (2017) found that learning improved when learners were presented with a biology text that used both words and pictures, particularly when words were delivered orally.

Applying Science of Learning Principles to Instruction for Emergent Bilinguals

Given the preponderance of evidence supporting enhanced learning as a result of the application of SOL principles, our selected SOL principles have a heightened importance for EBs. As educational leaders implement EB instructional leadership practices to develop teachers' EB instructional expertise, SOL principles should be discussed, emphasized, and applied as evidence-based practice for the design of multimedia instruction in schools. As noted in the literature (Vera et al., 2022), educational leaders may gain from models of the SOL principles in practice to support development of teachers' expertise. Therefore, in this section we present an example of multimedia instructional materials that demonstrates selected SOL principles discussed previously, sequenced according to how they may be applied to the design of a multimedia lesson. Because it can be inferred that those reading this article are proficient in English, we use Italian language examples so the reader will experience them as an EB might experience a similar example in English. We assume most of this article's readers are not proficient in Italian and, therefore, this Italian example may assist readers in gaining first-hand knowledge of how the application of the selected SOL principles supports second language learning.

Italian Text Example

This experiential second language reading example requires you to read through the following two-paragraph passage from an Italian fifth grade social studies textbook (Figure 1), noting any information that you are able to comprehend without referring to outside sources (such as Google). As you read, jot down in English anything you are able to comprehend in the Italian text.

Figure 1

Information Presented Only through Text

Cinque secoli fa arrivò a Gubbio un certo Giorgio Andreoli, lombardo, che cominciò a fabbricare ceramiche. Erano piatti e vasi ai quali, mediante una sua lavorazione segreta, egli

riusciva a dare meravigliosi riflessi dei colori dell'arcobaleno. Erano tanto belli che alcuni di questi pezzi sono oggi conservati nei piú importanti musei del mondo.

Si dice che Mastro Giorgio non svelasse mai a nessuno il suo segreto, ma da lui i ceramisti di Gubbio qualche cosa devono aver imparato, se ormai da cinque secoli producono ceramiche di squisita fattura; e in particolare (con una tecnica scoperta mezzo secolo fa) quei vasi neri e lucidi chiamati búccheri, che ripetono le forme e i fregi degli antichissimi modelli originali etruschi.

Note. This passage could be read silently or listened to while an Italian speaker reads it aloud.

Discussion of Italian Text Elements

As you read the passage in Figure 1, there was much non-essential information that had to be sifted through to gain understanding of key points through finding recognizable cognates (words that look or sound similar in two languages and have the same meaning in both) that you could decode to make sense of the passage. As Cummins (2021) has shown, when EBs are presented with new information verbally and without the context of extralinguistic cues (e.g., pictures) not only do they struggle to understand and learn the new information, they also are deprived of an opportunity to learn new language associated with it.

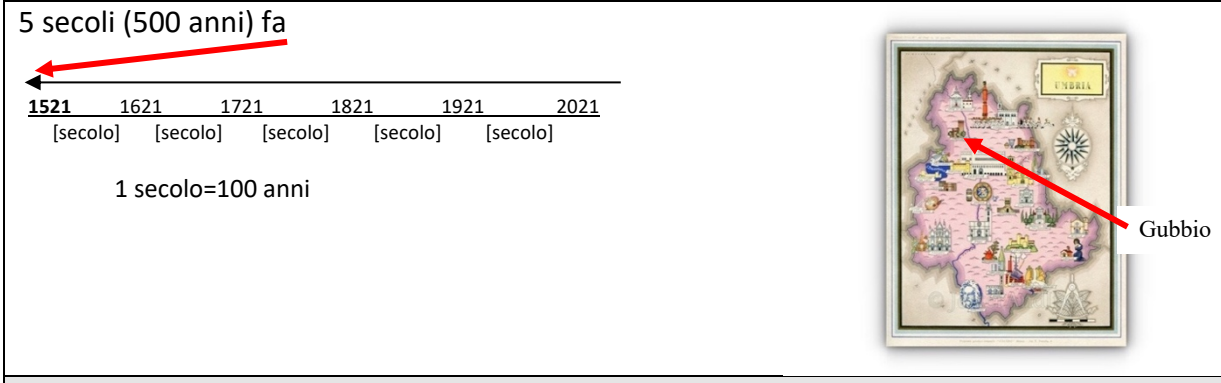
Italian Multimedia Instruction Example

In contrast to this purely verbal, non-multimedia approach to conveying the lesson objective, we can examine the effectiveness of conveying the content of this lesson through multimedia instruction that follows the selected SOL principles. The following multimedia display of key terms and corresponding images (Figures 2 and 3) unlocks essential meaning from the text through reducing extraneous processing, managing essential processing, and fostering generative processing. This is accomplished by (a) building prior knowledge, (b) limiting the amount of text to key terms, (c) using words and pictures, (d) placing printed words next to pictures, and (e) highlighting key terms, following the principles of *pretraining*, *coherence*, *multimedia, spatial contiguity,* and *signaling* to help EBs construct cognitive representations. Additionally, when presented as a recorded, narrated slide presentation or live by an instructor, as key terms and corresponding images are presented to EBs, spoken words are also used, following the principle of *temporal contiguity.* While these processes promote general learning, when considering the language aspects of learning any concept for EBs, these principles are especially critical. We apply these principles in Figure 2, which is divided into three slides and Figure 3, which presents one slide. As with the text example, read through each slide, noting what you understand from the multimedia presentation of the essential information from the written text in Figure 1.

Figure 2

Slides 1-3: Main Information of the Text Presented through Multimedia

SLIDE 1



Cinque secoli fa	***a Gubbio***

SLIDE 2


Giorgio Andreoli	***fabbricava ceramiche (piatti e vasi)***

SLIDE 3


piatti di tutti i colori e	***vasi di tutti i colori.***

The use of images in Figure 2 clarifies meaning from the text that an EB who is not yet fluent in Italian could not deduce, such as events in history described by complex verb tenses as well as cultural and specific geographical elements presented in the text without background information. In Slide 1 of the multimedia presentation, the timeline establishes the beginning of the historical events in the 16th century. Communicating the time of events in the past requires complex language, such as different verb tenses to show the sequence of events in the past, but a simple timeline can place events clearly in a specific period. In addition, there is signaling through arrows, drawing the readers' attention to essential information. The map places the location in an Italian town, Gubbio, in the region of Umbria, with an arrow signaling the town on

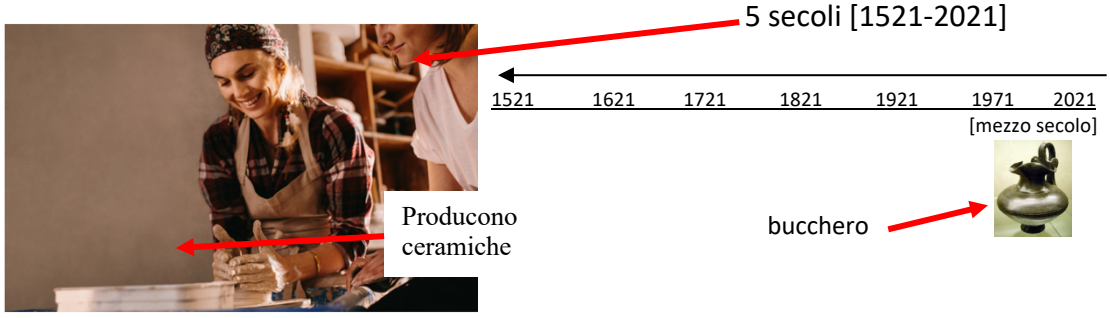
the map. Thus, the SOL principles of coherence (presenting essential information), multimedia (words and pictures presented simultaneously), and signaling (highlighting information) are applied. The row of text underneath the labeled images in Slide 1 states, “Five centuries ago, in Gubbio…”

In Slide 2, the painting on the left identifies a historical figure, while the photo on the right depicts pottery making. The row of text below the images continues, “Giorgio Andreoli made ceramics (plates and vases).” To convey the type of pottery, Slide 3 shows plates and vases of different colors, with the words “plates of all colors and vases of all colors” in the row below. In addition to the coherence and multimedia principles presented in Slide 3, the spatial contiguity is applied, clearly marking each illustration with a word or sentence label that describes it. Figure 3 presents Slide 4, with more complex information. Again, note what you understand from the multimedia presentation of the essential information from the written text in Figure 1.

Figure 3

Slide 4: Main Information of the Text Presented through Multimedia

SLIDE 4



Da 5 secoli (500 anni) i ceramisti di Gubbio producono ceramiche.	***Da mezzo (½) secolo (50 anni) i ceramisti di Gubbio producono búccheri (vasi neri).***

Slide 4 shows an image of pottery making indicating the action (producing ceramics) and the time span (1520-2021). It also shows the timeline presented previously in Slide 1 but now focusing on a recent timeframe, 1971-2021 [half century] next to a photo of a unique type of vase, a “búcchero,” that began to be produced 50 years ago. In Slide 4 linguistic complexity is increased gradually by presenting short sentences and corresponding images. Pretraining now starts to move beyond just key terms to include sentences. Slide 4 uses signaling, spatial contiguity and multimedia to support EBs as they process sentences in Italian. Signaling is used with a key term or phrase (producono) and corresponding picture. Underneath Slide 4 there are two sentences, which read “For five centuries the pottery makers of Gubbio have produced ceramics. For a half (1/2) century (50 years), the pottery makers of Gubbio produce búccheri (black vases). These sentences contain the key word or phrase and are signaled as well through highlighting. Slide 4 uses multimedia and spatial contiguity principles to assist EBs in gleaning the historical event presented in the sentence. The visuals of the vase and timeline and corresponding words and the signaling used in the sentence support EBs in the processing of the sentence found in the figure.

To summarize, from the information that was extracted from the text (Figure 1) and which thereby reduced extraneous information and simplified complex language, the multimedia presentation (Figures 2 and 3) provided images, diagrams, and labeling to communicate the main information from the original text. Putting together the text beneath each of the four slides, we have the following translated summary: "Five centuries ago, in Gubbio, Giorgio Andreoli, made ceramics (plates and vases), plates of all colors and vases of all colors. For five centuries (500 years) the pottery makers of Gubbio have produced ceramics. For a half (1/2) century (50 years) the pottery makers of Gubbio produce búccheri (black vases)." The multimedia examples in the preceding figures demonstrate that the main points of the text are comprehensible through the reduction of extraneous details in the text and the inclusion of illustrations for each point. Providing the multimedia summary of main points not only reduces the cognitive load on working memory required to comprehend the content of instruction, but it also promotes learning the language associated with it.

Returning to the original text presented in Figure 1, we can see how the application of the six SOL principles in Figures 2 and 3 supported EBs. Through this multimedia instructional presentation, EBs were provided with Italian language inputs coupled with extralinguistic clues that helped them home in on the essential information describing the history of artisanal practices, attend to the complex information presented, and build a cognitive representation of Italian artisanal practices. Depending on EBs' language acquisition level, the multimedia presentation could be used in place of the original text for beginning level EBs, while more advanced EBs could be presented with the original passage following the multimedia presentation. In either case, the use of coherence, signaling, spatial contiguity, multimedia, and pretraining principles facilitates EBs' unlocking of the Italian language and the social studies lesson objective.

Conclusion

For this discussion, we intentionally presented a simple slideshow example, which we envisioned could be used with print and/or digital multimedia content. This was intended as an entry point for educational leaders to consider the use of SOL principles in the design of EB instructional content as they implement EB instructional leadership practices to advance EB outcomes. Educational leaders are key to developing teachers' EB expertise through various instructional leadership practices (DeMatthews & Izquierdo, 2020; Clark & Chrispeels, 2022). To lead EB learning effectively, educational leaders need models of effective EB pedagogy in practice (Vera et al., 2022), like the one presented here. SOL principles and their application are vital to dual language instruction so that EBs can develop second language proficiency and are able to access new learning simultaneously. Furthermore, as schools and school districts acquire more sophisticated digital multimedia instructional materials/tools for EBs' second language learning, it is critical that educational leaders tasked with selecting and creating instructional materials have set criteria to ensure that digital materials align to SOL principles (see Li & Lan, 2021 for more information). Likewise, educational leaders responsible for supporting and evaluating EBs's teaching and learning also benefit from understanding the SOL principles and their application in multimedia instruction (print or digital), so they can guide dual language teachers and other teachers of EBs to advance students' academic outcomes. Ultimately, when SOL principles are

applied to multimedia instructional materials (i.e., materials that include words and pictures) for second language learning, effective inputs can be achieved, resulting in continued EB achievement.

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