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Improving Second Language Lexical Acquisition Through Personalization and Contextualization: A Look at Intrinsic Cognitive Load Reduction Strategies

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IMPROVING SECOND LANGUAGE LEXICAL ACQUISITION THROUGH PERSONALIZATION AND CONTEXTUALIZATION: A LOOK AT INTRINSIC COGNITIVE LOAD REDUCTION STRATEGIES

by

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ABSTRACT

IMPROVING SECOND LANGUAGE LEXICAL ACQUISITION THROUGH PERSONALIZATION AND CONTEXTUALIZATION: A LOOK AT INTRINSIC COGNITIVE LOAD REDUCTION STRATEGIES

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Cognitive load reduction strategies traditionally seek to reduce the amount of extraneous mental effort required of the learner. Researchers, through effective instructional design, seek to eliminate load-causing agents that are extraneous to the learning topic at hand. However, cognitive load theory research has now shifted to also include the exploration of strategies that seek to reduce the inherent complexities of the target topic itself. The current study seeks to apply two such intrinsic cognitive load reduction strategies—personalization and contextualization. Previous research suggests that cognitive load can be reduced by personalizing the learning environment, which serves to meet the interests of each learner as well as to provide a familiar environment, or prior knowledge script, for the learner. By utilizing instructional materials for which learners already have an established script, personalized materials are able to reduce the number of novel elements that must be individually processed by the learner, and by so doing, effectively reduce cognitive load. Research also suggests that personalized learning environments can also be more intrinsically motivating for learners, a tenant that is again assessed in the current study.

Intrinsic cognitive load reduction research likewise suggests that new topics be presented serially, and in isolation from confounding authentic contexts when possible, in order to reduce the number of elements that must be simultaneously processed that might otherwise outstrip

learners' available cognitive resources. Contrarily, second language acquisition research suggests that new target lexical items are best learned through inferring a new term's meaning through a rich authentic context. Studies contend that learners are able to map a lexicon's form to its meaning most effectively when new terms are interpreted through highly contextualized imbedded learning environments.

The current study sought to determine how a multimedia tutorial's level of *personalization* and *contextualization* could be manipulated to improve foreign language lexical learning, reduce cognitive load, and improve motivation for learning. A sample population of beginning college Spanish language learners (n = 128) was subjected to four different versions of a multimedia tutorial (i.e., personalized-contextualized, personalized-decontextualized, generic-contextualized, and generic-decontextualized). Following the tutorial, learners were tested for their ability to retain the novel content and transfer this content to new environments. Additionally, learners were asked to rank their motivation for learning the new topic, and the cognitive load endured during the learning and testing processes.

Achievement results showed a significant interaction effect for personalization and contextualization. When learners were asked to solve a complex problem utilizing the new target lexical terms, personalized-contextualized learners and generic-decontextualized learners were more effective than their contemporaries. A significant interaction effect was also demonstrated for cognitive load, which suggested that personalized-contextualized and generic-decontextualized learners suffered less cognitive load when completing a complex task than other learners. Finally, results showed a positive effect for motivation demonstrated by learners who were exposed to a personalized learning environment as opposed to a generic learning environment.

Keywords: cognitive load, second language acquisition, personalization, contextualization, lexical learning, retention, transfer, and motivation.

This dissertation is dedicated to my wife, the real brains of the family, to my children whose mere existence and constant need of nourishment (temporal, intellectual, spiritual, and emotional) inspired its completion every single day, and to the great God of Heaven, who bore my scholarly griefs and carried my statistical sorrows.

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CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Introduction

Second language acquisition (SLA) research and cognitive load theory (CLT) research rarely intersect within the discipline of foreign/second language lexical acquisition (i.e., vocabulary learning). CLT research is concerned with the idea that the novice learner's cognitive resources can be easily overtaxed by poor instructional design and learning topics that are inherently complex. When cognitive load researchers investigate the cognitive strain placed on second and foreign language (i.e., L2) learners, studies typically target the acquisition of complex grammar topics instead of lexical acquisition topics because grammar is thought to be more heavily endowed with *interacting elements*, or, multiple interconnected pieces of a topic that must be simultaneously considered in order for learners to derive the topic's meaning. When a topic is inherently burdened with multiple interacting elements, heavy cognitive strain is often placed on a novice learner's limited working memory processing capacity. If a complex topic's processing requirements outpace a learner's cognitive resources due to poor design or an inherently difficult topic, learning may be adversely affected. Early CLT studies focused on improving the design of the learning environment in order to reduce cognitive load; however, current CLT research has begun to target the inherently complex topics themselves in an attempt to implement design strategies that will reduce the number of interacting elements faced by the learner, freeing up cognitive resources for processing.

CLT researchers have begun to contribute to the understanding that instructional design strategies can reduce the cognitive load caused by inherently complex learning topics (i.e., topics with heavy intrinsic cognitive load). One way in which designers can reduce a topic's intrinsic cognitive load is to present complex interrelated topics serially and in isolation of one another, at least initially, to reduce the amount of interaction among instructional elements (Blayney, Kalyuga, Sweller, 2010; Pollock, Chandler, & Sweller, 2002). Removing target elements from their complex authentic context reduces the simultaneous processing of these elements and serves to free up a learner's cognitive resources as they process these elements one-by-one. Another way in which CLT tries to reduce the inherent complexity of a topic is by personalizing lesson plans for each learner (Anand & Ross, 1987; Davis-Dorsey, Ross, & Morrison, 1991; Ginns, Martin, & Marsh, 2013; Herndon, 1987; Kartal, 2010; Lopez, 1990; Mayer, Fennell, Farmer, & Campbell, 2004; Moreno & Mayer, 2000; Moreno & Mayer, 2004; Ross, 1983; Ross & Anand, 1987; Ross, McCormick, Krisak, & Anand, 1985; Ross, McCormick, & Krisak, 1986). When learners are faced with math word problems, for example, that are customized to include the names of their friends and topics with which they are familiar and prefer, such as baseball, instead of word problems with generic names and obscure topics, learners are more readily able to process the familiar elements and cognitive strain is reduced (Davis-Dorsey et al., 1991). Personalized lesson plans are also believed to increase motivation among learners (Davis-Dorsey et al., 1991; Mayer et al., 2004; Ross et al., 1985). The current study suggests that L2 lexical acquisition, although not targeted previously by CLT research, presents an ideal environment for testing the ways in which manipulating a lesson's level of personalization and contextualization may reduce the topic's intrinsic cognitive load. Additionally, the current study seeks also to contribute to the currently scant collection of L2 lexical acquisition research.

Just as CLT research has not yet targeted L2 lexical acquisition, second language acquisition (SLA) research itself has overlooked L2 lexical acquisition in favor of, perhaps, more readily accessible language topics, such as grammar acquisition, discourse analysis, and phonology (Lafford, Collentine, & Karp, 2003). Nevertheless, acquiring a robust lexicon proves highly practical for the L2 learner. As a few cases in point, research shows that most errors in the L2 are a result of lexical errors, and native speakers, with whom learners will interact, deem errors of the lexicon more serious than grammatical errors (Gass & Selinker, 2001). Other research suggests that lexical knowledge, rather than grammatical knowledge, serves to mediate grammar and phonology abilities/conceptualization, and perhaps language production at large (Gass & Selinker, 2001; Levelt, 1989). Finally, research indicates that grammar and vocabulary knowledge are closely related and that lexical acquisition plays a vital role in foreign/second language acquisition and use (Lafford & Collentine, 1987; Zimmerman, 1997). Despite its key role in language acquisition, the lexicon has been ignored by many L2 researchers. Perhaps the acquisition of foreign language lexical knowledge has not been extensively researched because some studies have assumed that lexical items can best be acquired implicitly or incidentally (Ellis, 1994; Gass, 1999). Yet, studies have found that lexical acquisition can see significant improvements through explicit instructional interventions (Ellis, 1994). The current study seeks to test this premise.

Just as L2 acquisition studies have ignored the L2 lexicon, cognitive load studies have not fully utilized L2 classrooms to investigate cognitive load reduction. What’s more, studies that specifically explore L2 *lexical* acquisition through a cognitive load framework are nowhere to be found in the literature (Plass & Jones, 2005). Cognitive load studies that seek to reduce intrinsic cognitive load are specifically poised to benefit from investigating complex L2 lexical acquisition topics as their experimental subject matter because lexical content is endowed with multiple interacting elements (some lexical topics more than others). Additionally, L2 lexical acquisition topics can be easily, by turns, decontextualized (i.e., isolated, serialized) as well as contextualized (i.e., presented within a meaningful context). SLA studies suggest that the acquisition of lexical content is facilitated by augmented *contextualization* (Collentine, 2006; Ellis, 1994; Haastrup, 1991; Lee & VanPatten, 2003; Klee & Barnes-Karol, 2006; Shrum & Glisan, 2005; Terrell, 1986). On the other hand, CLT research suggests that *decontextualizing* complex content and presenting it serially reduces the cognitive load faced by learners and therefore enhances learning (Blayney et al., 2010; Pollock et al., 2002). The present study sought to determine how these fields of investigation, seemingly at odds with each other, might find common ground.

Additionally, L2 lexical acquisition studies might benefit intrinsic cognitive load reduction research due to the ease with which this subject matter can be personalized. Personalizing the instructional content, as noted, is another novel way by which current research studies are attempting to reduce a complex topic's inherent complexity (Davis-Dorsey et al., 1991; Mayer et al., 2004; Ross et al., 1985). The current study investigated ways in which L2 lexical acquisition instruction can be personalized and decontextualized, despite its inherent complexity, providing an ideal platform for testing the effectiveness of innovative intrinsic cognitive load reduction strategies. The study also sought to determine whether learners benefit most from cognitive load reduction strategies that personalize and decontextualize the instructional content, as suggested by CLT research (Blayney et al., 2010; Davis-Dorsey et al., 1991; Mayer et al., 2004; Pollock et al., 2002; Ross et al., 1985), or from allocating L2 lexical learning within a meaningful context as suggested by SLA research (Shrum & Glisan, 2005).

Literature Review

The Evolution of Second Language Acquisition Research and Practice

L2 pedagogy has seen wide theoretical swings since the birth of the field, some 40 years ago. These changes have tended to loosely parallel advancements in learning theory and general psychological theory (Plass & Jones, 2005). Early efforts to monitor the way languages were taught and learned sought to corroborate the effectiveness of a structural approach to L2 learning. This approach, heavily influenced by behavioristic ideals, sought to teach the learner another language through discrete point grammatical drill and practice exercises that were completely decontextualized and removed from any authentic (real world) application. Lexical learning followed suit, presenting the learner with lengthy tables housing target L2 terms in one column, followed by their native language translations in another (Shrum & Glisan, 2005). Language learners were seen as a vessel to be filled with language-specific grammar rules and with the target L2 lexicon. After enough drill and practice, researchers believed that the L2 would begin to take hold in the learner's mind through habit formation.

The cognitive approach to learning had an important effect on language acquisition and began a transformation of the field. Cognitivists assumed that the mind boasted a vast neural network of prior knowledge structures that influenced the way learners would integrate new L2 grammar structures and lexicon within this network (McGilly, 1994; Palinscar, 1998; Slamecka & Graf, 1978; Steffe & Gale, 1995). For the first time, the mental processes that are involved in learning new grammar and lexical items were considered. The mind was assumed to contain innate cognitive structures especially akin to language learning and that these structures played a more vital role in learning than did external behavioral reinforcement (Chomsky, 1957). An emphasis was placed on the development of linguistic competencies based on prior learning, and the authentic environment in which learning the L2 occurred. Researchers began to move toward the idea that L2 learning could be done *implicitly*, in a way that mimicked the way the learner acquired the mother tongue, trusting the human mind's innate ability to *acquire* language, rather than to explicitly *learn* a language (Chomsky, 1965).

These cognitivist ideas gave rise to the *natural approach* to language learning (Krashen, 1982; Krashen & Terrell, 1983). This approach suggested that the L2 could be acquired, not learned, by the human mind, much in the same way that the native language is acquired through authentic interactions with more capable peers, rather than through explicit learning. Exposing learners to massive amounts of L2 input within an authentic context of language use would eventually facilitate implicit (or incidental) language acquisition, much the same way the native tongue is acquired (Krashen, 1982). When this theory was applied to practice, classrooms began to subjugate learners to massive L2 input sessions in which they were encouraged to read and listen to the target language in large quantities without any encouragement to produce the L2 verbally or through written mediums (Shrum & Glisan, 2005).

With the advent of constructivist learning theories, critics of the natural approach to language learning began to emerge and rally behind the idea that a disconnect between learners' competence and performance was forming (McLaughlin, 1987; Munsell & Carr, 1981; Lightbown, 2004). Learners' comprehension of the L2 differed widely from their ability to produce the L2 and critics suggested that learners needed to play a more active role in negotiating their own meanings within the target language in environments of actual L2 use. In order to facilitate *output* (or language production) learners needed to attend more fully to language *form*, not just to language *meaning* (VanPatten, 1990). Some researchers began to argue that the limited cognitive resources available to learners did not allow them to simultaneously make meaning from written and verbal input in their environment and at the same time process that input's formal features (e.g., morphology, syntax) (VanPatten, 1990). Input alone was not sufficient to produce the kind of grammar and lexical learning that was necessary to produce language.

Reacting to the realization that learners were not capturing linguistic forms from the input, researchers began to tout the importance of *intake.* Intake is language that is actually comprehended by the learner within an input-rich environment, and later used to produce *output* in the L2 (Shrum & Glisan, 2005). The idea that learners needed to actually attend to specific linguistic forms in the input led to comprehensible or modified input and to the input processing approach (processing instruction) to language learning (VanPatten, 1990). Processing instruction considered that learning an L2 differs from learning a native tongue in that the learner carries certain linguistic preferences and biases from the native tongue to the task of acquiring an L2 which often preclude the learner from attending to target lexical and grammatical structures (VanPatten & Cadierno, 1993). Processing instruction seeks to modify the input in order to make it more comprehensible for the learner while maintaining its authenticity and, at the same time, making target formal features of the language more salient, facilitating intake. Constructivists suggest that learners will then idiosyncratically produce language based on their own individual budding language knowledge system (or interlanguage) which will vary from that of other learners (Selinker, 1974). As learners interact with their peers and with native speakers of the target language, they will negotiate meaning and acquire new meanings through these interactions and negotiations. Next, learners will begin to integrate these new structures and lexical items into their individualized L2 knowledge base (Swain and Lapkin, 1995).

Sociocultural theories about learning suggest that interaction and output play key roles in constructing a linguistic knowledge base for each learner (Long, 1981). Through the negotiation of meaning with their peers and with native speakers of the target language, learners not only solidify their knowledge gleaned from authentic input, they also notice gaps in their ability to produce the L2 (Swain, 1995). As learners notice gaps between what they can say and what they want to say, they recur to the input of more capable L2 users for positive evidence models of their communicative goals. As newly acquired structures and lexical items are utilized in negotiated conversations centered on authentic topics and language goals that are intrinsically motivating for learners, the language student has the ability to automatize these structures, making them easier to produce in subsequent interactions (Ellis, 1997).

Lexical Acquisition

SLA theory and practice have evolved tremendously over the last fifty years. The field has emerged from its roots in behaviorism and language learning as habit formation, to its current theoretical base in constructivism. Today, learners are believed to form their own individualized linguistic systems through contextualized interactions with authentic input, paying close attention to target linguistic forms (intake), and then these systems are solidified (or automatized) through production (output) with fellow learners and native speakers. This focus on constructivism and social learning theory, that has so fully colored current L2 pedagogy, has led to a communicative approach to language teaching that situates learning within a highly communicative framework in which language students form their own meanings and grammar/lexical structures by means of communicative tasks. Problem-based learning tasks in the target language, content and task-based instruction in which learners are taught a skill through the L2, discovery grammar, and lexical learning through authentic reading activities, have all become the norm in the highly contextualized L2 classroom. Nevertheless, innovative lexical acquisition activities, specifically, have become somewhat lost in the shuffle.

Current research remains largely silent regarding how constructivist and social learning theories might specifically be applied to lexical acquisition in another language (Collentine, 2006; Lafford, Collentine, Karp, 2003). Studies to date largely relate to the use of various types of annotations to facilitate incidental and targeted lexicon learning through glossed reading activities (Chun & Plass, 1996a, 1996b; Jones, 2001; Jones & Plass, 2002; Plass, Chun, Mayer, & Leutner, 1998, 2003). Targeted lexical learning activities often utilize modified texts in order to teach the to-be-acquired lexical items through various glossing prescriptions (e.g., picture, text, video glosses, etc.). Although the research is mixed, considerable consensus seems to point to the idea that when learning lexical items through reading activities, the practice of glossing targeted words is effective, especially when glosses utilize multimedia (Chun & Plass, 1996a).

Multimedia, or the use of words and pictures instead of words alone, to acquire lexical content, is supported by SLA research through *binding* (Terrell, 1986). Binding refers to the process whereby a learner links a word to its semantic meaning (Terrell, 1986). Mapping form to meaning can be a complex process which can easily consume a learner's attentional resources; the insertion of multimedia, such as pictures and video, to accompany target lexical items proved more effective than textual glossing techniques also designed to facilitate lexical acquisition (Chun & Plass, 1996a; Al-Seghayer, 2001; Yoshii & Flaitz, 2002). Thus the research bears out that the combination of to-be-learned verbal information is most effectively acquired when paired with supportive pictorial information (Chun & Plass, 1996a, 1996b; Jones, 2001; Jones & Plass, 2002; Plass et al., 1998). These findings are also supported by the Cognitive Theory of

Multimedia Learning's *multimedia principle* which states that learning through text and pictures is more effective than learning through text alone (Mayer, 2009).

Lexical acquisition research has invested heavily in studies that corroborate the use of multimedia to support the acquisition of the L2 lexicon through glossed reading activities (binding) as noted. However, constructivist L2 lexical acquisition activities also employ other solutions to the L2 lexicon acquisition dilemma. Constructivism suggests that any activity in which learners are encouraged to—infer their own meanings for a target lexical term through meaningful context clues, map these meanings onto the word's form, and process these items deeply by utilizing them in diverse contexts—will be effective in promoting lexical acquisition (Ellis, 1994; Haastrup, 1991; Shrum and Glisan, 2005). These principles have been applied to lexical acquisition in many ways, such as by teaching learners strategies for reading comprehension and utilizing mnemonics, contextual guessing strategies, utilizing multimedia cues to infer meaning, and finally, linking target terms with other terms through semantic mapping and word families (Lafford et al., 2003). Multimedia and the use of semantic mapping in order to integrate target terms within a word family are of particular import to the current study.

Semantic mapping is the process by which learners build maps that relate a target key word to multiple related words in the same *family* of terms (Johnson & Pearson, 1978). As learners see target terms placed within a broader context of a family of like terms, they are more readily able to map (bind) the target term's meaning to its form and acquire the lexical item (Terrell, 1986). Research suggests that terms' rich meanings, acquired in this way, are more easily recalled (Morin & Goebel, 2001). The current study seeks to utilize multimedia (pictures and text) and a semantic map presentation strategy to instruct Spanish language learners regarding family relationships lexical items.

Constructivism and Language Learning

Inherent learning difficulties emerge when pedagogues and researchers indiscriminately apply current SLA methodologies to L2 instruction, especially when these methodologies are analyzed through the lens of cognitive load theory. Constructivism suggests that to-be-acquired L2 content should be presented in a context that the learner will deem meaningful and authentic. Learners are then encouraged to pick through this authentic input and seek out the target linguistic items, infer their meaning, and then map these meanings to multiple lexical and morphosyntactic forms (e.g., verb conjugations that vary widely for tense, mood, and aspect). Critics claim that novice learners cannot simultaneously process input for form and meaning without overtaxing the cognitive resources of the learner (VanPatten, 1990). Complex authentic contexts overwhelm the learner, especially in the L2 where learners are forced to think through already complex problem spaces (in the case of problem based learning), as well as complex authentic contexts, all by means of the L2 which in itself constitutes an entirely new communication system for the learner (Sweller, 1988; Kirschner, Sweller, & Clark, 2006). Lexical items are not typically considered high in cognitive load because often, these items can be processed serially (Sweller, Ayers, & Kalyuga, 2011). However, the current study suggests that load placed on the learner can quickly become elevated when attempting to acquire L2 lexical items, especially when the meaning of target lexical terms can only be derived through their dependence on other terms (i.e., multiple interacting elements), such as when learners infer meaning from semantic maps or glossed reading selections. Cognitive load research would point to the idea that these interacting elements have the potential to overwhelm the cognitive resources of novice L2 learners (Sweller, 1988). Thus we see that current trends in SLA research, which prompt instructors to allocate target lexical items within an authentic and meaningful context in order to facilitate intake, remain at odds with cognitive load theory research which suggests that lexical items be considered in decontextualized environments in order to reduce superfluous load causing agents.

Notwithstanding the seeming theoretical conflict between current SLA research and CLT, L2 lexical acquisition presents an interesting opportunity for CLT research due to the facility with which the second language lexicon can be presented within a meaningful context, and contrarily, be presented serially and in isolation (decontextualized). The current study seeks to analyze complex lexical learning through both contextualized and decontextualized instruction as suggested by SLA and CLT research respectively.

Cognitive Load Theory and Second Language Acquisition

CLT has been widely researched in disciplines of science and mathematics, but few studies have sought to apply the theory to the discipline of second and foreign language instruction and acquisition (Plass & Jones, 2005). As mentioned, studies that have recurred in the L2 research generally seek to apply the theory to second language reading and listening comprehension (Borrás & Lafayette, 1994; Garza, 1991; Markham, 1999). However, cognitive load theorists have pointed out that improved comprehension is not necessarily equivalent to learning (Sweller et al., 2011). Learning is facilitated when learners are asked to retain new information and transfer that information to new tasks, such as when learners in the L2 classroom are taught new grammar or lexical structures and are asked to produce these structures in new environments (Mayer, 2009; Montrul, 2011). These types of learning situations are extremely common in L2 classrooms, indicating that the field of second language acquisition is ripe for the application of CLT studies that are designed to improve learning. Sweller (1993) highlighted second and foreign language *grammar* learning as a *par excellence* example of subject matter that would be expected to be intrinsically high in cognitive load. Notwithstanding, L2 *lexical* acquisition has not been analyzed under the cognitive load microscope because researchers have assumed it bereft of interacting elements and therefore low in intrinsic cognitive load (Sweller, 1993). However, as shown in the current study, even some lexical acquisition topics in the L2 classroom can pose problems to learners due to high intrinsic cognitive load caused by multiple interacting elements. The current study sought to determine if the retention and transfer of a complex L2 lexical topic could be improved and cognitive load could be decreased through intrinsic cognitive load reduction strategies.

Limited Capacity of Working Memory

The utility of cognitive load theory as applied to instructional contexts lies in the idea that working memory is limited. The information processing theory suggests that as new to-be-learned information is perceived by the senses, it is then processed by working memory where it is prepared for integration into the mind's vast neural network of previously established schemata that compose the mind's network of long term memory (Atkinson & Shiffrin, 1968). Where long term memory is thought to be virtually limitless, working memory is drastically more limited (Baddeley, 1992; Miller, 1956). Early research suggested that the mind can handle no more than five to nine chunks of new information at any one time (Miller, 1956), while further research has indicated that working memory, when processing new information, is even more limited (Sweller, van Merriënboer, & Pass, 1998). This current theory proposes that processing information (i.e., comparing/contrasting, organizing, etc.) reduces the cognitive capacity of most learners so that they can effectively manipulate no more than two or three elements or chunks of information at a time. Instructional designs that do not take into account the learners' limited working memory capacity are destined to result in a breakdown in learning and ineffective instruction (Sweller et al., 1998).

One method of taking into account the limited capacity of learners' working memory is to reduce their exposure to elements that might cause extraneous processing. Working memory engages in two types of processing when attempting to learn new information (i.e., integrate new information into the long term memory network), extraneous processing and essential (or germane) processing (Sweller et al., 2011). In other words, the to-be-processed material, if it causes the mind to engage in processing that is essential to comprehending the topic at hand, is thought to be endowed with essential or intrinsic cognitive load (Carlson, Chandler, & Sweller, 2003; Moreno & Park, 2010; Paas, Renkl, & Sweller, 2004; Sweller, 1993; Sweller & Chandler, 1994). Intrinsically challenging topics are those topics which are composed of many interacting elements (Sweller et al., 2011). The most challenging topics are those in which working memory must simultaneously consider all of the interacting elements that compose the topic in order to derive meaning of the whole. Information containing many interacting elements is thought to be high in intrinsic cognitive load, and therefore, to consider such topics, working memory will be highly occupied with essential processing (Carlson et al., 2003; Leahy & Sweller, 2005). Instructional environments that engage the mind in extraneous processing, (i.e., environments that result in working memory's processing of elements of information that are not germane to learning the target instructional topic), are thought to be endowed with extraneous cognitive load. Since extraneous cognitive load is not related to learning the topic at hand, instructional designs would do well to reduce or eliminate elements that trigger extraneous processing in order to free up as much of the mind's cognitive capacity as possible for tackling elements high in intrinsic cognitive load that require essential processing (Mayer & Moreno, 2003). The human mind engages in both essential (germane) and extraneous processing when considering new material that is endowed with intrinsic and extraneous cognitive load, respectively (Kalyuga, 2011; Sweller et al., 2011). These load types are additive and if they ever outstretch the cognitive capacity of the student, learning breaks down as seen in Figure 1.

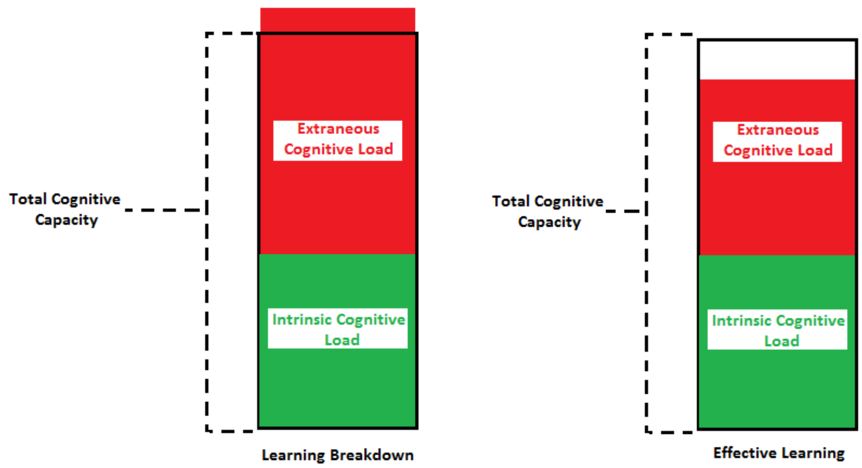

Figure 1. Learning breakdown and effective learning respectively.

The question for instructors and instructional designers resides here, in the limited capacity of working memory. Will the total cognitive capacity of the learner be outstretched by the target material's intrinsic cognitive load *plus* the extraneous cognitive load imposed upon the learner by the learning environment? If the answer is *yes*, steps must first be taken to reduce the amount of extraneous processing elicited by the learning environment.

Reducing Extraneous Cognitive Load

Since extraneous elements are not intrinsically related to the target instructional topic, rather they are often born through flaws in the design of the learning activities and environments, instructional design research has predictably begun its quest to improve instruction here. Reducing extraneous processing through effectively designed instruction will serve to free up a learner's working memory resources so that it can more effectively process all elements inherent to the target topic. Myriad studies have already sought to improve learning by way of utilizing extraneous cognitive load reduction strategies; so many in fact that now, multiple meta-analyses persist in the literature (Ginns, 2005; Ginns, 2006; Höffler & Leutner, 2007). These analyses predominately herald the importance of extraneous cognitive load reduction. The research has produced multiple instructional design strategies that have been reduced down to design heuristics that hope to guide the design and development of effective instruction (Mayer, 2009). The current study's focus is not to continue to add to the vast extraneous load reduction research, but to consider the possibility of reducing intrinsic cognitive load. However, the present study does employ current extraneous load reduction research and heuristics.

One design heuristic that pretends to reduce cognitive load is the *multimedia principle* (Mayer, 2009, p. 223). This principle suggests that complex material can be learned more effectively through pictures and words than through words alone (Mayer, 2009). Mayer suggested that in order for target instructional material to be truly acquired, the learner must construct both a verbal and pictorial representation of the material as well as integrate this material into the vast neural network of previous knowledge structures housed in long term memory. When complex instruction is presented through words and pictures, the formation of these verbal and pictorial models is facilitated and the strain placed on learners' limited cognitive resources is reduced (Mayer, 2009).

In the current study, learners were faced with a complex learning task that threatened to outpace their cognitive capacity. When learning family relationship vocabulary terms in Spanish, in order to derive meaning from a term such as "cuñado" ["brother-in-law"], learners have to simultaneously process the new text, along with their concept for a parent, who is also married to a spouse, who has a brother. In this circumstance, the relationship between the parent and the brother of the parent's spouse is one of "cuñado". Processing these relationships involves multiple interacting elements, plus, learners are expected to process these terms in a language that is not native to them. Thus, we see that although lexical learning is not often seen as a task heavily steeped in cognitive load, certain topics that require the consideration of multiple interacting relationships in order to interpret meaning, such as family and extended family relationships, might be expected to subject learners to high levels of cognitive load (Carlson et al., 2003). Adhering to the multimedia principle, the current study elected to employ both words and pictures across all treatments.

The *modality principle* also plays an important role in the design of the present study (Mayer, 2009, p. 200). This principle suggests that pictures/diagrams and explanatory audio narrations are more effective than pictures/diagrams and visual text, especially when learners are seeking to acquire a complex topic with multiple interacting elements. Audio narrations are more effective "words" to accompany pictures in complex instructional environments than visual text due to the dual nature in which the human brain processes information. Dual coding theory suggests that the mind processes information in a visual and a verbal channel (Paivio, 1971). When the visual channel (visual words and pictures) becomes overtaxed, cognitive load in the visual channel can be offloaded to the verbal channel by converting visual text to audio narrations (Paivio, 1990). Rather than unnecessarily burden the learner's visual channel, the current study employs a family pedigree chart diagram complete with pictures of family members, along with audio narrations that explain family relationships and Spanish family lexical terms. Nevertheless, in low cognitive load L2 lexical acquisition contexts (such as when individual target terms are processed serially) research suggests that learners can benefit from binding visual text with their pictorial referents (Chun & Plass, 1996a, 1996b; Jones, 2001; Jones & Plass, 2002; Lee & VanPatten, 2003; Plass et al., 1998; Terrell, 1986). In the present study, visual text was also presented to the learner serially, prior to inserting the picture within the broader context of the complex diagrammatic family pedigree chart where audio narrations sought to explain the pictures within the broader context of the whole family. In this way the study allowed for binding between the visual text target Spanish vocabulary term and its pictorial referent, while at the same time avoiding the possible cognitive overload of the visual channel (due to the use of pictures *and* visual text) and what Mayer calls unnecessary "redundancy" (due to the use of audio narrations *and* redundant visual text to explain pictures) (Mayer, 2009, p. 118). Although numerous *extraneous* cognitive load reduction decisions informed its design, the current study sought to depart from traditional cognitive load research by investigating the possibility of implementing personalization and serial processing strategies in order to reduce *intrinsic* cognitive load when learning a complex foreign language lexicon.

Reducing Intrinsic Cognitive Load

Personalization. Once thought unmodifiable, some research studies are beginning to consider if steps can be taken to reduce the intrinsic cognitive load of the content itself (Pollock et al., 2002; Ross et al., 1985; Sweller, 1994; van Merriënboer, Kirschner, & Kester, 2003; van Merriënboer & Sweller, 2005). One methodology utilized by researchers to reduce the cognitive load inherent to complex learning topics is that of personalizing the instructional content. Personalization comes in many forms, but most studies to date have focused on personalizing the style of the instructional language by shifting language from a non-descript third person to a conversational language style that addresses the learner directly in the second and first person (d'Ailly, Simpson, & MacKinnon, 1997; Ginns et al., 2013; Kartal, 2010; Mayer et al., 2004;

Moreno & Mayer, 2000; Moreno & Mayer, 2004). These researchers have suggested that addressing the learner directly and removing abstract third person referents triggers more active processing of the to-be-learned content, resulting in better learning.

Other researchers have sought to not only personalize the language style, but to also utilize computer technology in order to adapt the learning environment to better fit the background and interests of each learner (Anand & Ross, 1987; Davis-Dorsey et al., 1991; Herndon, 1987; Lopez, 1990; Ross, 1983; Ross & Anand, 1987; Ross et al., 1985; Ross et al., 1986). These studies first employed a survey to discover the background and interests of the learners. This information was then utilized to adapt mathematics word problems and other lesson content to include, not generic information, but information supplied by the learner in order to adapt the context of the instruction to reflect the interests of the learners. The studies discovered that personalizing content in this manner had a positive effect on learning.

Davis-Dorsey et al. (1991) suggested that personalizing problems to reflect the predilections of learners serves to facilitate the creation of the problem space. When solving complex problems, the initial set-up of the problem space, or the act of laying out the elements involved in the problem that must be considered in order to come to a resolution, can be very complex (Sweller, 1988). Solving even relatively simple problems requires that the learner simultaneously process multiple referents that compose the problem, hold them in working memory while determining the goal of the problem and at the same time make calculations in order to solve the problem. When all of these interacting problem space elements are simultaneously processed in working memory, few cognitive resources remain for integrating new information into long term memory, causing the learner to remain bereft of effective strategies for solving similar problems in the future (i.e., learning breakdown). Employing, for example, math word problems that contain the names of the learners' friends, and the subject matter that is familiar to the learners, serves to reduce cognitive load and makes problems easier to mentally represent in relationship to prior knowledge, since referents already form an integrated part of the learners' mental schemata framework (Anand & Ross, 1987; Davis-Dorsey et al., 1991; Ross & Anand, 1987; Ross et al., 1986). Symons and Johnson (1997) argued that content that is related to the self is more effectively retained due to the fact that the schema (i.e., neural network of prior knowledge) for the self is often highly developed and well used (i.e., automatized); in this way, personalizing content promotes elaboration and organization of the target content because mental structures are already in place and the problem space is more easily established. When cognitive resources are not swallowed up by problem space creation, more resources can be utilized for learning novel target information (Cooper, Tindall-Ford, Chandler, & Sweller, 2001; Kalyuga, Chandler, Tuovinen, & Sweller, 2001; Tuovinen & Sweller, 1999). The current study draws upon this personalization literature and seeks to determine how using personalized language (e.g., Spanish's second person, informal register) combined with personalized content (e.g., actual names and photographs from learners' family pedigree charts) might be used together to improve retention and transfer of target Spanish familial relationships lexical items.

Rewording abstract narrations to form more conversational style instructional texts and actually adapting the instructional content/context to individually reflect the prior knowledge of the learner might have differentiated effects. Davis-Dorsey et al.'s (1991) findings suggest that personalized conversational wording and personalized contexts have a positive effect for novice learners, but the ameliorating effects of rewording begin to diminish for more advanced learners.

Thus, the current study, composed of entry-level Spanish learners utilized Spanish's second person informal register for all learners with differentiated context personalization per treatment.

Despite the differentiated effects demonstrated by rewording and context personalization, both forms of customizing lesson plans for each individual learner resulted in improved interest and motivation for learning (Anand & Ross, 1987; Davis-Dorsey et al., 1991; Ginns et al., 2013; Herndon, 1987; Kartal, 2010; Lopez, 1990; Mayer et al., 2004; Moreno & Mayer, 2000; Moreno & Mayer, 2004; Ross, 1983; Ross & Anand, 1987; Ross et al., 1985; Ross et al., 1986). However, the degree of motivation fostered by personalization varies significantly across studies (Ginns et al., 2013). As in other personalization studies, the current study sought to measure the ways in which personalized lesson plans might serve to motivate learners and capture their interest for the target topic in an attempt to improve learning.

Contextualization. Finally, another way in which the intrinsic load of complex topics can be reduced is through breaking up interacting elements, at least initially, and presenting these elements serially, in isolation one from another, in a decontextualized environment. Language instruction has increasingly moved to a highly contextualized model in which target lexical terms are presented within an authentic real-world context, together with a family of other like terms, and that meaning is made by considering the whole and not just the parts (Collentine, 2006; Klee & Barnes-Karol, 2006; Shrum & Glisan, 2005). However, highly contextualized (i.e., constructivist) environments have been criticized by some cognitive load theory sympathizers due to their often overly complex nature (Kirschner et al., 2006; Sweller et al., 2011; van Merriënboer et al., 2003). Highly contextualized lexical presentations, in which novel terms depend upon other terms for their interpretation, run the same risk faced by all content containing multiple interacting elements—overuse of working memory and an eventual breakdown in learning. However, some researchers have sought to reduce intrinsic cognitive load by artificially decontextualizing linked content and presenting elements of the target content piece by piece, serially and in isolation, at least initially, especially when the audience is composed of novice learners (Blayney et al., 2010; Pollock et al., 2002). While reducing a complex topic into fragmented individual parts is sometimes impossible, and when possible, nearly always results in an artificial learning environment, cognitive load is effectively reduced. Investigations suggest that novice students are especially benefited in their learning of new material by presenting complex novel information serially, bereft of complicating context (Blayney et al., 2010; Pollock et al., 2002).

Opportunities for Cognitive Load Theory Research

Here we see that L2 instruction presents a special and interesting case for cognitive load research. Familial relationships are inherently complex when learning an L2 because one cannot fully understand the term “primo” [“cousin”], for example, without also understanding the terms “tío” [“uncle”], as well as “hijo” [“son”]. However, where simultaneously processing all of these novel terms might otherwise overwhelm the novice learner, L2 instruction boasts the singular advantage of drawing upon the learner’s native tongue in order to make a direct connection between the target term “primo” and a term that already forms part of the learners’ schema for familial relationships, “cousin”. By relating “primo” directly to “cousin” the learner is able to effectively skip the second language’s interacting elements and relate the target term directly to prior knowledge. Moreover, prior cognitive load research might suggest that such a move could serve to reduce cognitive load and thereby facilitate retention and transfer of novel L2 lexical content (Blayney et al., 2010; Pollock et al., 2002). Isolating and decontextualizing lexical terms by pairing them with decontextualized first language translations circumvents current SLA theory. The SLA binding principle suggests that learners should pair target L2 lexical terms directly with visual (pictorial) referents within a highly meaningful and authentic context and avoid translations all together (Lee & VanPatten, 2003; Terrell, 1986). The current study sought to determine how presenting target lexical content in environments stripped of contextualizing detail, rather than within meaningful and authentic contexts, might facilitate retention and transfer as well as reduce cognitive load during learning and use.

Problem Statement and Research Questions

Familial relationships in an L2 learning environment can prove complex, with multiple interacting elements, especially for novice learners. However, this content provides a special opportunity for intrinsic cognitive load researchers because it can be easily personalized and decontextualized. The current study drew upon cognitive load research to reduce essential processing by means of personalizing the instructional content for each learner. By catering learning materials to specific learners, the study attempted to reduce the inherent cognitive strain caused by the lexical topic and improve learning. Additionally, the study sought to determine whether presenting L2 lexical items in contextualized environments (as espoused by SLA research) or decontextualized environments (as championed by CLT research) would prove more effective in improving learning and cognitive load reduction. Finally, the study also sought to determine how personalization and contextualization prescriptions affect a learner's motivation to acquire target lexical items. The study investigated the following questions:

1. What is the effect of personalization and contextualization prescriptions (e.g., +personalization/-personalization, +contextualization/-contextualization) on the learner's ability to retain and transfer lexical content?

2. In what ways do personalization and contextualization prescriptions influence the amount of cognitive load experienced by the learner?
3. How do personalized/generic and contextualized/decontextualized lesson plans affect the learner’s motivation for acquiring lexical content?

CHAPTER II

METHOD

The study employed a multimedia lexical tutorial that participants controlled and completed at their own pace within a prescribed time limit. The tutorial was designed to teach each participant Spanish lexical terms related to the family (e.g., mother, father, brother-in-law, cousin, etc.). Additionally, participants engaged in a survey to determine motivation, completed posttests focusing on retention and transfer in order to determine lexical acquisition, and rated themselves with cognitive load metrics designed to determine the mental load caused by the tutorial as well as the posttest instruments. All study participants were administered a demographic survey, as well as a family relationships lexical items pretest which sought to measure each participant's prior knowledge regarding familial relationships Spanish terms. The pretest was designed to ensure that all of the randomly assigned groups were indeed equal regarding their prior knowledge in this domain. Finally, all participants engaged in an online pedigree chart worksheet activity in which they were required to upload three-generation family tree charts for use in the personalization treatments of the study.

Participants

The participants for this study were recruited from 10 entry-level Spanish language courses at a rural mid-sized community college in northern Arizona. The study enlisted 128 participants (n = 128), with the sample consisting of 52 males and 76 females. The mean age for the participants was 25.16 years (SD = 12.86). Participants hailed from a variety of ethnic backgrounds with the majority self-identifying as *White* (69.5%). Participants also self-identified as *Hispanic* (10.1%), *American Indian* (*Native American*) or *Alaskan Native* (3.9%), *Asian or Asian American* (3.9%), *Black* (*African American*) (2.3%), *Hawaiian* or *Pacific*

Islander (1.6%), and *Other* (8.6%). Data regarding majors of study were also gathered which rendered a wide variety of avenues of academic endeavor; however, only one of the participants in the study identified *Spanish* or a related field as an intended major. Finally, participants also recorded how many previous semesters of Spanish study, in high school or college, they had previously completed. Participants declared that they had, on average, studied 1.7 previous semesters of Spanish (*SD* = 1.9), at some point in their high school/college studies.

Design

The research design consisted of a 2 (personalized/generic) X 2 (contextualized/decontextualized) between subjects crossed factorial ANOVA design. As a true experimental design, the study employed treatment groups composed of randomly assigned participants. Each treatment group was subjected to a different multimedia Spanish tutorial that sought to teach immediate and extended family lexical content (see Appendix A for all lexical items presented in the tutorial). Outcome measures included Spanish lexical achievement (retention and transfer) measures, cognitive load measured at the time of the instructional intervention and during the follow-up assessments, and participant motivation toward the instruction.

Instructional Treatments

The study employed random assignment of all participants to one of four treatment groups (see Table 1). Each treatment distinguished itself from the others by the type of presentation delivered to the participants through the instructional tutorial.

Table 1

Study's Four Treatment Types

Treatments	Personalization		Contextualization	
	Personalized	Generic	Contextualized	Decontextualized
1	|X|		|X|	
2	|X|			|X|
3		|X|	|X|	
4		|X|		|X|

Personalized/Generic. The *personalized/generic* factor related to the amount of personalization presented in the tutorial (see Appendices B-E). *Personalized* tutorials boasted presentations that housed information from the participants' real lives and instruction that addressed the participant directly, through Spanish's second person informal register (the formal register was not used during this study). Participants placed in the *personalized* group were presented with a tutorial that was unique to each individual learner. The tutorial taught the participant about family relationship lexical items in Spanish by using his/her actual family. For example, if the participant's father was named "Ralph" the tutorial would present "Tu papá, Ralph" ["Your father, Ralph"] through pictures (a picture of Ralph himself) and accompanying explanatory audio narrations. Participants placed in the *generic* group received instruction about family relationships in Spanish that used fictitious names that were not personalized but that were generic to the learner, for example, "El padre es Julio" ["The father is Julio"]. Pictures that were employed in the generic tutorial were not uploaded by the participant; rather, stock photos were used in this group to highlight the family relationship lexical items on a generic pedigree chart.

Contextualized/Decontextualized. Participants in the *contextualized* group were presented the target lexical term within the broader context of the whole family (see Appendices B-E). This group was shown a screen that housed a three-generation family tree pedigree chart, then they were presented with target lexical items within the context of the whole family shown on the chart. Additionally, *contextualized* learners received instruction that contextualized target lexical terms within their meaningful relationships across familial ties, for example, "Julio es tu primo, el hijo de tu tío, Javier" ["Julio is your cousin, the son of your uncle, Javier"]. The *decontextualized* group (or isolated group) saw a tutorial that did not consider the broader context of the family, but presented the target lexical items serially, one at a time, without reference to the rest of the family. For example, the learner viewed a screen with a labeled picture of Julia and an explanation stating, "Julia es tu madre" ["Julia is your mother"]. No further references were made to the rest of "la madre's" familial connections.

In sum, all four treatment groups were subjected to a tutorial presentation with static picture elements accompanied by explanatory audio narrations. These presentations were either *personalized* (i.e., utilized names and pictures from the participant's actual family) or *generic* (i.e., utilized generic pictures and names). The target lexical terms that were presented with either *personalized* or *generic* picture/audio presentations also were presented with either contextualizing detail or with decontextualized lack of detail. The *contextualized* group received the new target terms integrated into a rich context within the wider three-generation family pedigree chart. The *decontextualized* group saw these terms presented to them in isolation, without referencing the rest of the family. Appendices B, C, D, and E house examples of the multimedia tutorial for all four treatment groups, *personalized-contextualized, personalized-decontextualized, generic-contextualized,* and *generic-decontextualized,* respectively.

Finally, it should be noted that to facilitate binding of the target lexical item, a slide with visual text of the target term was presented in all treatments together with explanatory audio narrations (Chun & Plass, 1996a, 1996b; Jones, 2001; Jones & Plass, 2002; Lee & VanPatten, 2003; Plass et al., 1998; Terrell, 1986). In the case of "madre" ["mother"], for example, participants in all treatments were first presented with a slide containing visual text of the target term "madre" followed by an explanatory audio narration stating, "'madre' es 'mother' en inglés" ['madre' is 'mother' in English] (see Appendix F). Thus we see that explanatory audio narrations offered for the *generic-contextualized* treatment allocate the target term "hermano" ["brother"] within a nuclear family in which learners must depend on knowledge of the previously presented related terms "padre" ["father"] and "hijo/hija" ["son/daughter"] in order to derive the meaning of the target term, "hermano," as seen in Appendix D. Thus, the *contextualized* learner would expect to receive more information through the explanatory audio narration than the decontextualized learner, who received terms presented in isolation, serially, and bereft of context. In this way, learners placed in *decontextualized* (isolated) treatments may have depended heavily upon the audio English translations that were presented to all treatment groups (see Appendix F), in order to make meaning of the target Spanish lexical items.

Instruments

Demographics and Prior Knowledge. At the onset of the study, participants completed a demographic survey, and a Spanish familial relationships lexical prior knowledge pretest. The survey sought to gather information regarding participants' prior experiences with Spanish as well as demographic information (see Appendix G). The pretest sought to ensure that all of the randomly assigned participant groups were indeed equal regarding their familial relationships lexical knowledge prior to the instructional intervention. In order to reduce possible confounds that might result from learning from the pretest, participants were asked to simply write the Spanish equivalents of English familial relationship lexical terms (see Appendix H). Pretests were dichotomously objective in nature, with each item either being marked as correct or incorrect with no allowances for spelling errors due to the phonetic nature of Spanish language orthography. Every correct pretest term was awarded one point causing scores to fall on a scale between 0 and 22 points. A KR-20 reliability coefficient was calculated for the pretest instrument, indicating that the test was highly reliable, (r = .92, n = 128).

Cognitive Load and Motivation. Participants were given the opportunity to rate themselves for cognitive load during and after the instructional tutorial and after the post-test lexical achievement measures. During the tutorial, participants completed three review exercises in which they attempted to mentally complete a family pedigree chart with their newly acquired lexical knowledge. After each of the three review exercise participants ranked themselves for expended *mental effort* using a nine-point single scale mental effort metric (1 = very, very low mental effort; 9 = very, very high mental effort) (Paas, 1992). A total tutorial mental effort score therefore fell on a scale between 0 and 27 points. Participants also used the nine-point scale to measure their mental effort at three points during the written fill-in-the-blank task resulting in a mental effort score between 0 and 27 points. Learners' scores were subjected to a Cronbach's α analysis of internal consistency, which indicated that the mental effort scale was highly reliable for the both the tutorial (α = .85, n = 126), and the fill-in-the-blank transfer task (α = .83, n = 122). A single scale mental effort measurement of this type has been shown to reliably reflect actual cognitive load (Paas, 1992; Paas, Tuovinen, Tabbers, & van Gerven, 2003).

Immediately after the tutorial, participants rated the entire presentation for cognitive load using the adapted NASA TLX rating instrument (Gerjets, Scheiter, & Catrambone, 2006) (see

Appendix I). The same instrument was used following each of the three posttests. The adapted NASA TLX ratings were subjected to a Cronbach's α calculation to determine internal consistency. The results suggested that the tutorial ($\alpha = .78$, $n = 126$), the free recall posttest ($\alpha = .79$, $n = 118$), the fill-in-the-blank posttest ($\alpha = .77$, $n = 120$), and the problem-solving tutorial ($\alpha = .81$, $n = 119$) proved to be reliable measures of cognitive load.

Finally, the amount of time learners spent on a task has also been used as an objective measure of cognitive load (Chandler & Sweller, 1991, 1992; van Gog & Paas, 2008). The research assumes that the greater the time learners spend on a task, the more mental effort the learners must exercise to successfully complete the task. The current study thus measured the time learners spent in attempting to complete the two *lexical achievement—transfer tasks* (measured in seconds). Learners were allotted a total of 900 seconds (15 minutes) to complete each task.

The study also sought to measure learners' feelings of motivation during the multimedia tutorial. Learners ranked their motivation to learn the target lexical items by means of their particular multimedia tutorial treatment using a survey adapted from prior personalization research (Ross, 1983; Ross & Anand, 1987) (see Appendix J). The results of the survey were subjected to a Cronbach's α calculation, which suggested that the survey was reliable ($\alpha = .74$, $n = 124$).

Lexical Achievement—Retention Task. Posttest measures sought to determine the level of learning obtained by all participants due to their randomly assigned multimedia treatment. Following the tutorial, participants completed the *free-recall posttest*. Participants were given paper and a pencil and instructed to recall as many target family relationship lexical items as possible (see Ross et al., 1985). Each item recalled and spelled correctly was objectively awarded one point. Items that were not recalled were awarded zero points, causing scores to fall on a scale from 0 to 22 possible points. Learners were permitted just three minutes to recall all target terms. Terms written by learners that were not terms targeted by the multimedia presentation were not scored. This instrument was designed to be free from interacting elements, and therefore elicit little to no cognitive load (see Appendix K). Learners' scores were subjected to KR-20 calculation of reliability with the instrument demonstrating high reliability (r = .89, n = 128).

Lexical Achievement—Transfer Tasks. Next, the participants completed the *written fill-in-the-blank posttest* (see Appendix L). This test asked learners to use a pencil to fill-in-the-blank based on contextualized audio prompts presented to them through a PowerPoint quiz. Learners utilized headsets to hear audio narration scripts, such as "El cuñado de mi madre es mi . . . ________ (correct answer = tío)" ["The brother-in-law of my mother is my . . . _________ (correct answer = uncle)"]. Participants then responded in writing on their answer sheets, filling in the blank with the correct lexical item. This task required the processing of two or more interacting elements at a time, as well as the *production* of the new written Spanish lexical items, and thus was deemed to demand an elevated level of cognitive effort. The instrument was designed to impose moderate cognitive load. Montrul (2011) suggested that the production of new items would be an accurate indication of learning, and would demonstrate the participants' ability to transfer their learning from a receptive to a productive task. The instrument was objectively scored as correct or incorrect with one point awarded for each correctly produced lexical item causing scores to fall on a scale from 0 to 22 possible points. Scores were subjected to a KR-20 calculation of internal consistency which ranked the instrument highly reliable (r =

.95, *n* = 126). As noted above, the researcher also tracked how quickly participants completed this posttest task.

The *problem-solving task* constituted the final posttest task employed by the study and was completed using paper and pencil. Participants received a series of clues on small pieces of paper and were asked to complete a blank family pedigree chart that was provided to them, based on the clues. For example, Clue 1: Marcelo es el abuelo [Marcelo is the grandfather]. Clue 2: Andrea tiene una hija [Andrea has a daughter]. Clue 3: La madre de Lisa está casada con Ramón [Lisa's mother is married to Ramón], etc. (see Appendix M). The participants were informed that they would be evaluated based on the speed and accuracy with which they were able to complete the problem-solving task. The instrument was then objectively scored with each correctly completed pedigree item equating to one point for the participant causing scores to fall on a scale from zero to ten possible points. A KR-20 calculation of internal consistency ranked the problem-solving task as highly reliable ($r = .89$, $n = 126$).

Participants who completed the entire pedigree chart were also timed for speed of completion (15 total minutes were allowed for the completion of the chart). Since multiple elements interacted with one another and learners were forced to establish a complex problem space using the new lexical items holistically (see Sweller, 1988), the exercise was designed to elicit elevated levels of cognitive load in the participants. The participants most benefited by their particular tutorial treatment were assumed to demonstrate the most accurate pedigree charts and/or the quickest completion times.

Retention tasks, such as free recall exercises, are good measures of initial learning and remembering (Mayer, 2009). However, transfer tasks, such as the *written fill-in-the-blank* activity and the *problem-solving task* are perhaps better measures of true learning (Mayer, 2009).

When learners are able to transfer their skills from one environment to a new environment they demonstrate that they have gone beyond rote memorization, and now “understand” the new content and have created a mental model for the new information (Mayer, 2009, p. 19). The current study employed both retention and transfer task instruments in order to capture data regarding the effectiveness of the target treatments in order to facilitate both remembering and understanding amongst the participants. All instruments employed in the study are listed in Table 2 in the order in which they were chronologically presented to participants.

Table 2

Instrument Summary in Order of Chronological Appearance During the Study

Instrument	What is measured? (by Research Question)	Scores	Analyses
Family relationships names and photos worksheet	NA	NA	Uploaded data used to create tutorials for treatment groups
Demographic survey	Demographics	Qualitative	Descriptive statistics
Family relationships pretest	Prior Knowledge	0 – 22	ANOVA
NASA TLX adaptation from Gerjets et al. (2006)	Research Question 2: Cognitive Load	0 – 500	ANOVA
Mental Effort Scale adaptation from Paas (1992)	Research Question 2: Mental Effort	0-27	ANOVA
Attitude Survey	Research Question 3: Attitude and motivation toward instructional materials	0 – 1300	ANOVA
Free-recall posttest	Research Question 1: Achievement—Recall of family lexical items	0 – 22	ANOVA
Written fill-in-the-blank task posttest	Research Question 1: Achievement—Transfer of family lexical items in written production task. Research Question 2: Cognitive Load—Time to completion	0 – 22, & time to completion 0-900	ANOVA
Problem-solving task posttest	Research Question 1: Achievement—Transfer of family lexical items in problem-solving task. Research Question 2: Cognitive Load—Time to completion	0 – 10, & time to completion 0-900	ANOVA

Procedure

All participants were encouraged to take part in the study due to the fact that the study would be the means by which they would learn family relationships lexical content, which constituted a required learning outcome for their course. Additionally, a personalized three-generation family pedigree chart that utilized each learner's family names and photos was to be used not only for the present study but also to complete another assignment in the Spanish course in the days following the study. Learners gave their written consent to permit the researcher to utilize their scores for the purposes of the study. In order to encourage learners to allow the researcher to use their scores, learners were told that those who permitted the use of their scores in the study and scored in the top 10% on the study's posttest instruments would be entered into a drawing for a chance to win a $50 gift card to a local retailer. One gift card was awarded. Providing a cash incentive may have shifted learners' intrinsic motivation for learning the target Spanish lexicon to an extrinsic desire to obtain the incentive. However, the researcher felt that since the study's stimulus materials would not affect the learners' class grade, or their standing in the class in any way, an extrinsic cash incentive would be justified. It was thought that such an incentive might help encourage the study's participants to expend maximum effort during the tutorial and posttest tasks.

In order to create personalized lesson plans, initial contact with the participants commenced approximately one month prior to the administration of the study itself. Learners were asked to complete an online worksheet which required the completion of a three generation family pedigree chart (i.e., grandparents, parents, and siblings). The online worksheet asked the participant to add information for their paternal and maternal grandparents, and then to work back down the pedigree chart to themselves, supplying names and uploading photographs of aunts, uncles, cousins, siblings, parents, grandparents and in-laws. These uploaded data were then used by the researcher to design personalized family relationship lexical tutorials for the participants in the *personalized* treatment groups. It should be noted that learners were encouraged to upload true and accurate information from their own family, regardless of its make-up, including non-traditional families (e.g., families with two mothers). Consequently, none of the learners assigned to the personalized treatments in this study uploaded familial information that could be construed as non-traditional. Learners that felt resistance to uploading information about their family (e.g., they were estranged from a particular family member) were encouraged to upload only information that they could easily gain access to and/or felt comfortable including in their family pedigree chart. When gaps emerged in a particular family pedigree chart, for example, when learners did not have a *hermana* [*sister*], the sister of the learner's mother was used in the instructional tutorial to teach the term. In the rare event that no relationship could be forged to teach the term *hermana,* the tutorial simply supplied the learner with all the information stipulated by the instructional treatment and included a summarizing phrase which stated that in the learner's family, no such *sister* relationship exists.

On the day of the study, participants entered the computer enabled classroom. There they were instructed to complete the paper and pencil demographic survey. Following the survey, each participant completed the paper and pencil pretest as a measure of prior knowledge concerning the target lexical acquisition topic. Finally, participants were each given a personalized weblink which, when navigated to, downloaded the tutorial which was individually created for and assigned to them, based on their random assignment to one of the study's four treatment groups. Tutorials for all treatments contained the same number of slides and were estimated to be equal in duration. Participants were permitted to navigate through the tutorial screens at their own pace. Nevertheless, all participants were encouraged to complete the tutorial by the end of a 25-minute time limit counted down for them on the projected computer screen.

During the tutorial participants were asked to self-rank the learning activity for mental effort at three points using the single item nine-point mental effort scale. At the conclusion of the entire tutorial, participants were asked to self-rank the learning activity as a whole for the cognitive effort that it demanded during the learning process. The adapted NASA TLX index was used to rank cognitive load. Next, all participants were administered the motivation survey to determine motivation and attitude concerning the tutorial instructional intervention to which they were assigned. This survey also served to clear working memory prior to the administration of the posttest battery of assessments.

Finally, participants were tested regarding their ability to retain and transfer the new lexical terms by completing each of the three Spanish lexical content achievement instruments: the *free recall* instrument (retention), the *written fill-in-the-blank* instrument (transfer), and the *problem-solving* instrument (transfer). After each instrument, the NASA TLX task load index prompted participants to rate the exercise for mental load. Participants also ranked their mental effort using the nine-point mental effort scale at three different points during the *fill-in-the-blank posttest* instrument. After completing the final cognitive load scale for the problem-solving instrument, participants were thanked for participating in the study. It should be noted that since the content of the tutorial formed part of the course's actual learning outcomes, the study took place during the course's natural class time when the instructor otherwise would have presented this content to the learners as a natural and normal part of the course sequence. Targeted courses met for two hours, two times per week, and the study, from beginning to end, encompassed approximately 1.5 hours.

CHAPTER III

RESULTS

The data were subjected to analyses that sought to respond to each of the study's three research questions. The results of these data analyses techniques are presented below, organized by each research question that the techniques pretended to address.

Prior to conducting analyses for lexical achievement, prior knowledge pretest data were gathered for all four treatment groups (*personalized-contextualized*, *personalized-decontextualized*, *generic-contextualized*, and *generic-decontextualized*). Zero to 22 points were possible on the pretest. Table 3 reflects participants' pretest performance across treatments.

Table 3

Pretest Performance Across Treatments

Treatment	*M*	*SD*	*n*
Personalized-Contextualized	7.35	5.56	31
Personalized-Decontextualized	6.63	4.81	30
Generic-Contextualized	6.26	4.87	34
Generic-Decontextualized	6.73	5.46	33
Total	6.73	5.12	128

All pretest scores were subjected to a one-way analysis of variance (ANOVA). The analysis discovered no significant differences across treatments based on pretest performance, $F(3, 124) = .25$, $p = .87$, $\eta_p^2 = .01$. Additionally, Levene's analysis confirmed the assumption of homogeneity of variances across treatments, $F(3, 124) = .57$, $p = .64$. These analyses suggest that prior to the instructional intervention, participant groups were assumed to be equal regarding their Spanish family relationships lexical prior knowledge.

Research Question 1: Retention and Transfer

The first research question sought to determine how learners' abilities to both retain and transfer new lexical items would be affected by the learning environment's level of personalization and contextualization. Participants' free recall posttest performance fell on a scale between 0 and 22 points, highlighted below in Table 4.

Table 4

Free Recall Posttest Performance Across Treatments

Treatment	*M*	*SD*	*n*
Personalized-Contextualized	17.16	4.38	31
Personalized-Decontextualized	15.63	4.78	30
Generic-Contextualized	15.12	5.40	34
Generic-Decontextualized	16.21	5.30	33
Total	16.03	4.97	128

These free recall posttest results were subjected to a between subjects 2 (personalized/generic) X 2 (contextualized/decontextualized) factorial ANOVA. The analysis resulted in a non-significant main effect of personalization on the free-recall posttest results, $F(1, 124) = .69$, $p = .41$, $\eta_p^2 = .005$. Likewise, a non-significant main effect of contextualization was found on the posttest free-recall results, $F(1, 124) = .02$, $p = .81$, $\eta_p^2 = .00$. Additionally, the free-recall posttest data did not reveal a significant interaction effect between personalization and contextualization, $F(1, 124) = 2.20$, $p = .14$, $\eta_p^2 = .017$.

The written fill-in-the-blank posttest sought to capture learners' abilities to transfer new target lexical knowledge to a written fill-in-the-blank task in response to an aural prompt. Participants' performance fell on a scale between 0 and 22 points, reflected in Table 5.

Table 5

Fill-in-the-Blank Posttest Performance Across Treatments

Treatment	*M*	*SD*	*n*
Personalized-Contextualized	14.13	7.09	31
Personalized-Decontextualized	11.20	7.34	30
Generic-Contextualized	10.64	10.64	33
Generic-Decontextualized	12.75	12.75	32
Total	12.18	9.46	126

These fill-in-the-blank posttest results were subjected to a between subjects 2 (personalized/generic) X 2 (contextualized/decontextualized) factorial ANOVA. Once again, non-significant main effects were observed for learners in the personalized, $F(1, 122) = .54$, $p = .46$, $\eta_p^2 = .004$, and contextualized $F(1, 122) = .10$, $p = .76$, $\eta_p^2 = .001$ multi-media presentation groups. Moreover, a non-significant interaction effect was observed between personalization and contextualization on the fill-in-the-blank transfer task, $F(1, 122) = 3.66$, $p = .06$, $\eta_p^2 = .029$

Finally, the problem-solving posttest transfer task set out to determine whether learners were able to transfer their knowledge gains to a problem-solving task. The results of their performance fell on a scale between 0 and 10 points and are shown in Table 6.

Table 6

Problem-solving Posttest Performance Across Treatments

Treatment	*M*	*SD*	*n*
Personalized-Contextualized	7.87	2.40	31
Personalized-Decontextualized	5.80	2.93	30
Generic-Contextualized	5.85	3.00	33
Generic-Decontextualized	7.72	3.37	32
Total	6.81	2.93	126

These problem-solving posttest results were subjected to a between subjects 2 (personalized/generic) X 2 (contextualized/decontextualized) factorial ANOVA. Non-significant main effects were observed for personalization, $F(1, 122) = .01$, $p = .92$, $\eta_p^2 = .000$, and contextualization, $F(1, 122) = .04$, $p = .85$, $\eta_p^2 = .000$. However, a significant interaction effect for personalization and contextualization was observed, when considering participants' abilities to solve a complex problem that utilized the new target family relationship lexical terms, $F(1, 122) = 14.02$, $p = .001$, $\eta_p^2 = .103$. Participants who learned the target terms through a personalized and contextualized multimedia tutorial performed better ($M = 7.87$, $SD = 2.40$, $n = 31$) than participants who learned the new terms in a personalized and decontextualized environment ($M = 5.80$, $SD = 2.93$, $n = 30$). Likewise, participants who learned the target lexical items in a generic (non-personalized) and decontextualized environment (*M* = 7.72, *SD* = 3.37, *n* = 32), performed significantly better on the problem-solving task than did their generic and contextualized counterparts (*M* = 5.85, *SD* = 3.00, *n* = 33). Figure 2 highlights this interaction effect.

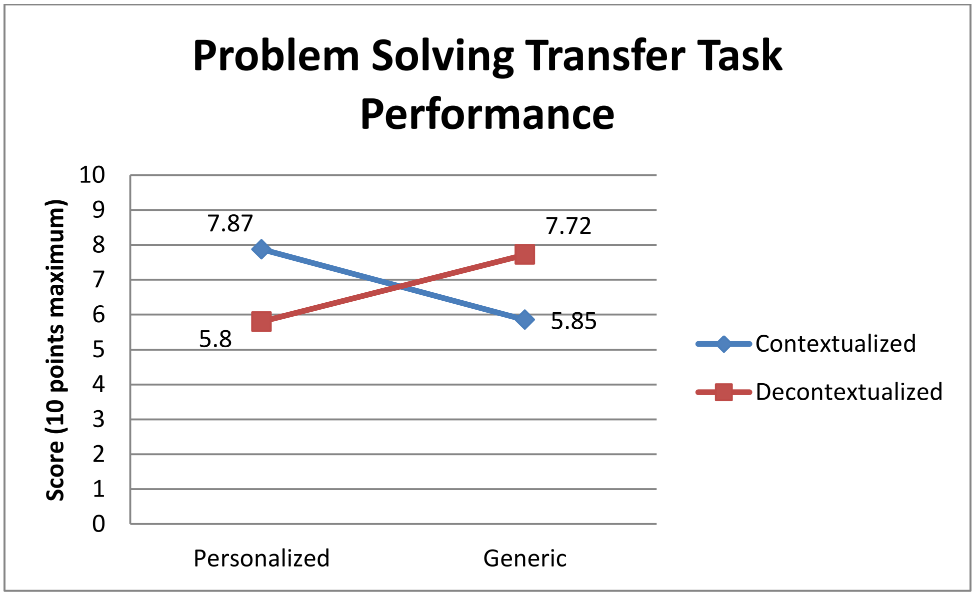

Figure 2. Significant interaction effect for learners' performance on the problem-solving posttest transfer task.

Contextualizing the learning environment affects learners exposed to personalized and non-personalized (generic) multi-media lessons differently when they are later instructed to solve complex problems that utilize their knowledge. Learners who receive a personalized multi-media tutorial lesson benefit from greater contextualizing details, whereas learners who receive a generic lesson perform best when their learning environment is stripped of contextualizing details.

Research Question 2: Cognitive Load

In addition to measuring learners' lexical knowledge performance, the study also aimed to determine in what ways personalization and contextualization might influence the amount of cognitive load experienced by the learner, both during the multi-media lexical item tutorial presentation, and later when applying the new target lexical items during the posttest tasks. The study employed multiple instruments designed to measure cognitive load. An adaptation of the NASA task load index (TLX) was employed after the multi-media tutorial as well as after each of the three posttests. A mental effort scale instrument was also employed during the tutorial and the written fill-in-the-blank posttest task. Finally, time to completion (in seconds) was recorded as a measure of cognitive load upon learners' completion of the written fill-in-the-blank task and following the problem-solving task (greater time to completion assumes greater cognitive load).

First, working load was determined by calculating the mean score of three different NASA TLX items, task demands, mental effort, and navigational demands, which were ranked on a scale from 0 to 100 points each. Working load was calculated following the multimedia tutorial and after each of the posttest tasks. Working load results are highlighted below in Table 7.

Table 7

Working Load Mean Score Across Treatments by Instrument

Instrument		Treatment				
		Personalized-Contextualized	Personalized-Decontextualized	Generic-Contextualized	Generic-Decontextualized	Total
Tutorial	*M*	39.23	46.40	42.11	44.20	42.99
	SD	20.68	20.06	22.61	20.79	21.04
	n	30	30	33	33	126
Free Recall Posttest	*M*	58.18	57.41	60.83	60.87	59.32
	SD	19.54	24.61	26.84	19.88	22.72
	n	28	27	31	32	118
Fill-in-the-Blank Posttest	*M*	70.43	73.44	76.50	73.50	73.47
	SD	18.15	19.93	21.17	22.78	20.51
	n	29	28	31	32	120
Problem-solving posttest	*M*	68.09	61.37	63.74	62.37	63.89
	SD	19.27	20.76	23.81	23.35	21.80
	n	31	28	30	30	119

Scores were subjected to a between subjects 2 (personalized/generic) X 2 (contextualized/decontextualized) factorial ANOVA in order to compare participants' working load scores across groups. The analyses resulted in non-significant main effect differences across treatments, as reflected in Table 8.

Table 8

Working Load Main Effect by Instrument

Instrument	**Factor**	**df**	***F***	***p***	η_p^2
Tutorial	Personalization	1	.008	.928	.000
	Contextualization	1	1.514	.221	.012
	Interaction	1	.455	.501	.004
	Error	122			
Free Recall Posttest	Personalization	1	.521	.472	.005
	Contextualization	1	.008	.931	.000
	Interaction	1	.009	.924	.000
	Error	114			
Fill-in-the-blank Posttest	Personalization	1	.659	.419	.006
	Contextualization	1	.000	.998	.000
	Interaction	1	.633	.428	.005
	Error	116			
Problem-solving posttest	Personalization	1	.174	.678	.002
	Contextualization	1	1.017	.315	.009
	Interaction	1	.442	.507	.004
	Error	115			

The adapted NASA TLX scores for working load were also analyzed individually for differences across treatment groups, focusing on task demands, mental effort, and navigational demands specifically, highlighted here in Tables 9, 10 and 11 respectively.

Table 9

Mean Score for Task Demands Across Treatments by Instrument

Instrument		Treatment				
		Personalized-Contextualized	Personalized-Decontextualized	Generic-Contextualized	Generic-Decontextualized	Total
Tutorial	*M*	47.97	60.00	54.88	54.88	54.43
	SD	23.40	20.38	25.65	22.23	22.92
	n	30	30	34	33	127
Free Recall Posttest	*M*	67.23	67.69	71.03	70.12	69.02
	SD	22.01	25.76	28.30	22.59	24.67
	n	30	29	34	33	126
Fill-in-the-Blank Posttest	*M*	81.50	86.93	89.64	80.28	84.59
	SD	14.81	15.28	16.14	25.63	17.97
	n	30	30	33	32	125
Problem-solving posttest	*M*	72.32	69.63	70.81	68.72	63.89
	SD	20.43	22.34	25.27	25.60	23.41
	n	31	30	31	32	124

Table 10

Mean Score for Mental Effort Across Treatments by Instrument

Instrument		Treatment				
		Personalized-Contextualized	Personalized-Decontextualized	Generic-Contextualized	Generic-Decontextualized	Total
Tutorial	*M*	45.70	48.20	49.03	48.42	47.84
	SD	24.03	27.75	26.81	24.79	25.85
	n	30	30	34	33	127
Free Recall Posttest	*M*	65.83	61.90	67.32	67.30	65.59
	SD	19.92	28.72	26.46	23.76	24.72
	n	30	29	34	33	126
Fill-in-the-Blank Posttest	*M*	79.40	80.00	85.76	81.13	81.57
	SD	15.99	21.50	19.29	22.42	19.80
	n	30	30	33	32	125
Problem-solving posttest	*M*	69.52	69.33	67.32	66.53	68.18
	SD	19.42	21.08	25.26	25.92	22.92
	n	31	30	31	32	124

Table 11

Mean Score for Navigational Demands Across Treatments by Instrument

Instrument		Personalized-Contextualized	Personalized-Decontextualized	Generic-Contextualized	Generic-Decontextualized	Total
		Treatment				
Tutorial	*M*	24.03	31.00	22.91	29.30	26.81
	SD	24.83	28.57	27.76	28.50	27.42
	n	30	30	33	33	126
Free Recall Posttest	*M*	39.31	46.86	43.65	43.22	43.26
	SD	30.41	33.40	33.88	31.15	32.21
	n	29	28	31	32	120
Fill-in-the-Blank Posttest	*M*	51.38	53.96	55.68	59.09	55.03
	SD	33.59	35.49	39.42	32.71	35.30
	n	29	28	31	32	120
Problem-solving posttest	*M*	62.42	47.54	53.17	52.83	53.99
	SD	28.28	28.49	31.85	31.67	30.07
	n	31	28	30	30	119

These data which reflect measurements of task demands, mental effort demands, and navigational demands were all subjected to a 2 (personalized/generic) X 2 (contextualized/decontextualized) between subjects factorial ANOVA to determine possible differences across groups. The results are presented below in Tables 12, 13, and 14 respectively.

Table 12

Main Effect of Task Demands Across Treatments by Instrument

Instrument	**Factor**	**df**	***F***	***p***	η_p^2
Tutorial	Personalization	1	.048	.827	.000
	Contextualization	1	2.152	.145	.017
	Interaction	1	2.155	.145	.017
	Error	123			
Free Recall Posttest	Personalization	1	.492	.484	.004
	Contextualization	1	.003	.960	.000
	Interaction	1	.024	.878	.000
	Error	122			
Fill-in-the-blank Posttest	Personalization	1	.050	.824	.000
	Contextualization	1	.347	.557	.003
	Interaction	1	4.934	.028*	.039
	Error	121			
Problem-solving posttest	Personalization	1	.083	.774	.001
	Contextualization	1	.319	.573	.003
	Interaction	1	.005	.943	.000
	Error	120			

Note. * Denotes a significant effect at $p < .05$.

Table 13

Main Effect of Mental Effort Across Treatments by Instrument

Instrument	**Factor**	**df**	***F***	***p***	η_p^2
Tutorial	Personalization	1	.149	.700	.001
	Contextualization	1	.042	.837	.000
	Interaction	1	.114	.736	.001
	Error	123			
Free Recall Posttest	Personalization	1	.601	.440	.005
	Contextualization	1	.198	.657	.002
	Interaction	1	.194	.661	.002
	Error	122			
Fill-in-the-blank Posttest	Personalization	1	1.094	.298	.009
	Contextualization	1	.318	.574	.003
	Interaction	1	.535	.466	.004
	Error	121			
Problem-solving posttest	Personalization	1	.361	.549	.003
	Contextualization	1	.014	.907	.000
	Interaction	1	.005	.942	.000
	Error	120			

Table 14

Main Effect of Navigational Demands Across Treatments by Instrument

Instrument	**Factor**	**df**	***F***	***p***	η_p^2
Tutorial	Personalization	1	.083	.774	.001
	Contextualization	1	1.856	.176	.015
	Interaction	1	.003	.954	.000
	Error	122			
Free Recall Posttest	Personalization	1	.003	.953	.000
	Contextualization	1	.365	.547	.003
	Interaction	1	.458	.500	.004
	Error	116			
Fill-in-the-blank Posttest	Personalization	1	.530	.468	.005
	Contextualization	1	.215	.644	.002
	Interaction	1	.004	.949	.000
	Error	116			
Problem-solving posttest	Personalization	1	.128	.721	.001
	Contextualization	1	1.894	.171	.016
	Interaction	1	1.732	.191	.015
	Error	115			

Table 12 demonstrates a significant interaction effect for personalization and contextualization, $F(1, 122) = 4.934$, $p = .028$, $\eta_p^2 = .039$, when considering cognitive *task demand* load (thinking, deciding, calculating, remembering, looking, searching, etc.) when completing a fill-in-the-blank transfer task. These findings suggest that learners suffer less cognitive load when applying their new knowledge to a transfer task when their initial learning environment is personalized and contextualized ($M = 81.50$, $SD = 14.81$, $n = 30$) or generic and decontextualized ($M = 80.28$, $SD = 25.63$, $n = 32$) than when faced with personalized-decontextualized ($M = 86.93$, $SD = 15.28$, $n = 30$) and generic-contextualized learning environments respectively ($M = 89.64$, $SD = 16.14$, $n = 33$). This interaction effect is highlighted in Figure 3.

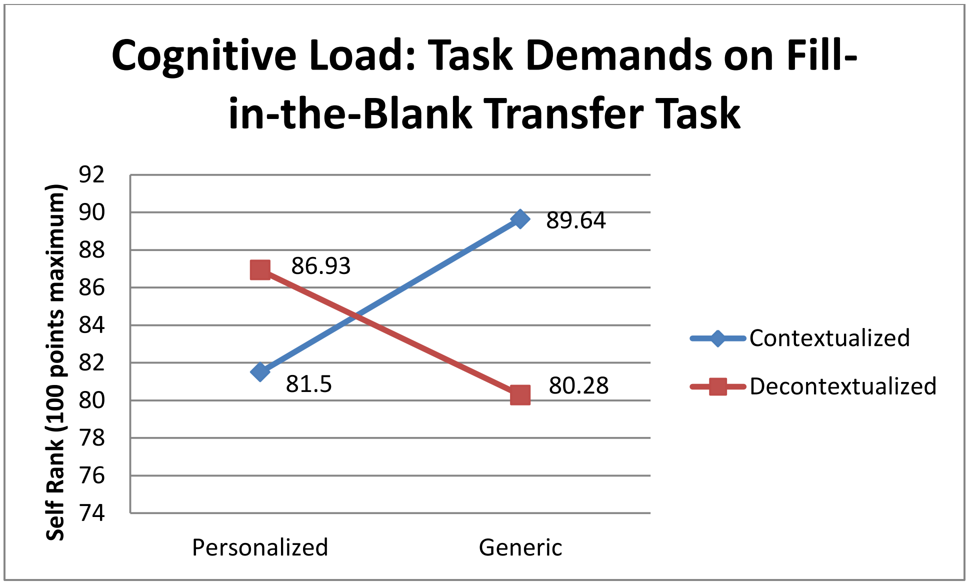

Figure 3. Significant interaction effect for learners' self-rankings of *task demands* on the fill-in-the-blank posttest transfer task.

The modified NASA TLX instrument also gathered data regarding learners' feelings of success and stress both during the multi-media tutorial and during the posttest instruments. Participants were asked to rank their feelings of stress when learning and using the new family relationships lexical terms from zero, no stress, to 100 very high levels of stress. Additionally, participants also ranked how successful they felt in learning and using these new terms on a 100 point scale from zero, very low amount of success, to 100, very high amount of success. Participants' self-rankings for *stress* and *success* are reflected in Tables 15 and 1 respectively.

Table 15

Mean Score for Stress Across Treatments by Instrument

Instrument		Treatment				
		Personalized-Contextualized	Personalized-Decontextualized	Generic-Contextualized	Generic-Decontextualized	Total
Tutorial	*M*	28.67	33.50	34.70	36.61	33.37
	SD	26.49	23.49	31.82	22.59	26.10
	n	30	30	33	33	126
Free Recall Posttest	*M*	53.45	56.79	55.48	58.75	56.12
	SD	25.67	28.94	32.28	25.82	28.18
	n	29	28	31	32	120
Fill-in-the-Blank Posttest	*M*	71.72	71.46	75.71	67.38	71.57
	SD	22.69	23.64	28.56	25.94	25.21
	n	29	28	31	32	120
Problem-solving posttest	*M*	48.61	47.86	54.50	57.83	52.20
	SD	28.61	26.33	33.20	25.85	28.50
	n	31	28	30	30	119

Table 16

Mean Score for Feelings of Success Across Treatments by Instrument

Instrument		Treatment				
		Personalized-Contextualized	Personalized-Decontextualized	Generic-Contextualized	Generic-Decontextualized	Total
Tutorial	*M*	73.40	69.67	61.67	77.70	70.61
	SD	24.58	16.66	23.67	19.04	20.99
	n	30	30	33	33	126
Free Recall Posttest	*M*	80.00	70.36	66.61	74.94	72.98
	SD	17.22	24.87	26.25	17.01	21.34
	n	29	28	31	32	120
Fill-in-the-Blank Posttest	*M*	62.45	45.36	53.87	56.75	54.61
	SD	26.15	33.28	34.39	31.11	31.23
	n	29	28	31	32	120
Problem-solving posttest	*M*	76.13	75.89	69.33	79.43	75.20
	SD	19.69	20.41	26.35	21.33	21.95
	n	31	28	30	30	119

These data were also subjected to a 2 X 2 factorial ANOVA. The results of these analyses of *stress* and *success* are reflected in Tables 17 and 18 respectively.

Table 17

Main Effect of Stress Across Treatments by Instrument

Instrument	**Factor**	**df**	***F***	***p***	η_p^2
Tutorial	Personalization	1	.940	.334	.008
	Contextualization	1	.512	.476	.004
	Interaction	1	.096	.757	.001
	Error	122			
Free Recall Posttest	Personalization	1	.149	.700	.001
	Contextualization	1	.407	.525	.003
	Interaction	1	.000	.995	.000
	Error	116			
Fill-in-the-blank Posttest	Personalization	1	.000	.991	.000
	Contextualization	1	.856	.357	.007
	Interaction	1	.756	.386	.006
	Error	116			
Problem-solving posttest	Personalization	1	2.271	.135	.019
	Contextualization	1	.060	.807	.001
	Interaction	1	.151	.698	.001
	Error	115			

Table 18

Main Effects of Feelings of Success Across Treatments by Instrument

Instrument	**Factor**	**df**	***F***	***p***	η_p^2
Tutorial	Personalization	1	.239	.626	.002
	Contextualization	1	2.631	.107	.021
	Interaction	1	6.795	.010*	.053
	Error	122			
Free Recall Posttest	Personalization	1	1.231	.269	.011
	Contextualization	1	.028	.868	.000
	Interaction	1	5.126	.025*	.042
	Error	116			
Fill-in-the-blank Posttest	Personalization	1	.060	.807	.001
	Contextualization	1	1.530	.219	.013
	Interaction	1	3.021	.085	.025
	Error	116			
Problem-solving posttest	Personalization	1	.161	.689	.001
	Contextualization	1	1.478	.227	.013
	Interaction	1	1.623	.205	.014
	Error	115			

Note. * Denotes a significant effect at $p < .05$.

The significant main interaction effects for the tutorial $F(1, 122) = 6.795$, $p = .010$, $\eta_p^2 = .053$, and the free recall posttest $F(1, 116) = 5.126$, $p = .025$, $\eta_p^2 = .042$, as highlighted in Table 18, suggest a significant interaction between personalization and contextualization, on the tutorial and free recall posttest task respectively. This finding suggests that students who received a personalized and contextualized tutorial (*M* = 73.40, *SD* = 24.58, *n* = 30) and those who received a generic and decontextualized tutorial (*M* = 77.70, *SD* = 19.04, *n* = 33) felt significantly more successful in learning the target lexicon during the presentation than did their respective personalized-decontextualized (*M* = 69.67, SD = 16.66, *n* = 30) and generic-contextualized (*M* = 61.66, *SD* = 23.67, *n* = 33) counterparts. This interaction effect difference is highlighted in Figure 4.

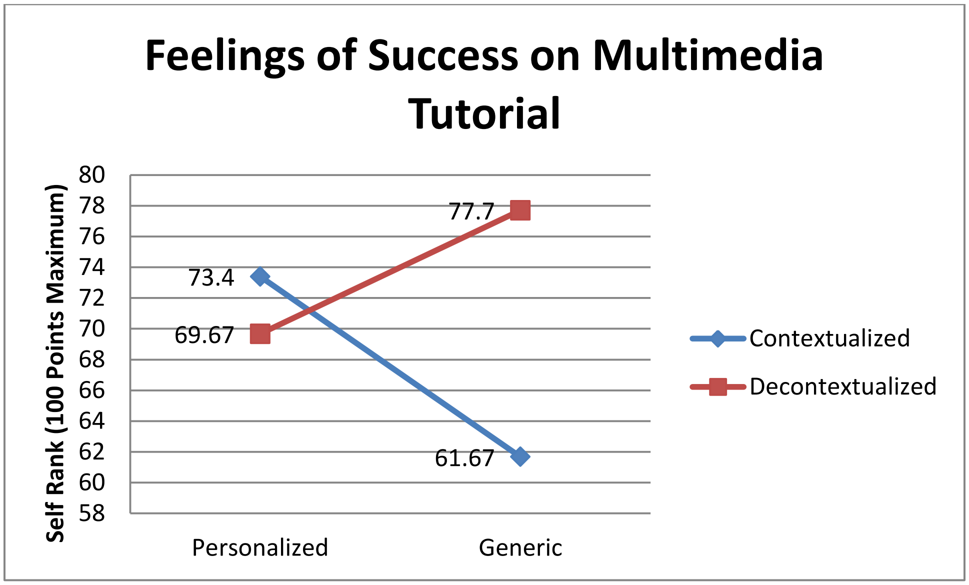

Figure 4. Significant interaction effect for learners' self-rankings of feelings of *success* on the multimedia tutorial.

Table 18 also reflects a significant interaction effect between personalization and contextualization on the free recall posttest, $F(1, 116) = 5.126$, $p = .025$, $\eta_p^2 = .042$. This finding might indicate that learners who received a personalized and contextualized tutorial (*M* = 80.00, *SD* = 17.22, *n* = 29) felt more successful than their personalized decontextualized counterparts (*M* = 70.36, *SD* = 24.87, *n* = 28) and that, by the same token, those learners who received a generic decontextualized tutorial felt more successful in recalling the target lexical terms (*M* = 74.94, *SD* =17.01, *n* = 32) than did their generic contextualized counterparts (*M* = 66.61, *SD* = 26.25, *n* = 31). This interaction effect is shown in Figure 5.

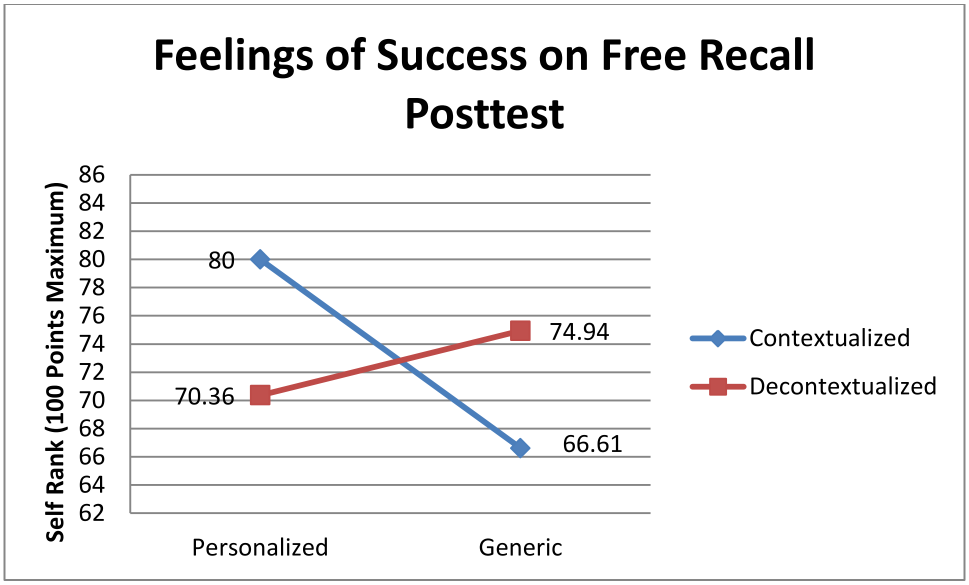

Figure 5. Significant interaction effect for learners' self-rankings of feelings of *success* on the free recall posttest.

This personalization/contextualization interaction effect seems to diminish as the posttest tasks increase in complexity. The interaction effect only approaches significance during the fill-in task $F(1, 116) = 3.021$, $p = .085$, $\eta_p^2 = .025$, and the effect is non-significant in the problem-solving task $F(1, 116) = 1.623$, $p = .205$, $\eta_p^2 = .014$.

Total time (measured in seconds) spent on the fill-in-the-blank posttest task and the problem-solving posttest task (transfer tasks) was also used as an objective measure of cognitive load, reflected in Table 19. Maximum time allotted for completion of these tasks was 900 seconds (15 minutes).

Table 19

Time (in seconds) Needed to Complete Transfer Tasks

		Treatment				
Instrument		Personalized-Contextualized	Personalized-Decontextualized	Generic-Contextualized	Generic-Decontextualized	Total
Fill-in-	*M*	612.13	612.60	559.22	603.47	596.85
the-Blank	*SD*	160.61	205.47	190.42	172.85	182.34
Posttest	*n*	31	30	32	32	125
Problem-	*M*	343.13	363.80	351.97	363.37	355.57
solving	*SD*	117.85	117.50	138.68	124.52	124.64
posttest	*n*	31	30	33	30	124

The study assumed that more time spent on the task would be an indication of greater cognitive load experienced by learners. However, no significant main effect of time was observed for either posttest instrument when the data were subjected to the 2 X 2 between subjects factorial ANOVA, as reflected in Table 20.

Table 20

Main Effect of Time Across Treatments Measured in Two Posttests

Instrument	**Factor**	**df**	***F***	***p***	η_p^2
Fill-in-the-Blank Posttest	Personalization	1	.898	.345	.007
	Contextualization	1	.467	.496	.004
	Interaction	1	.447	.505	.004
	Error	121			
Problem-solving posttest	Personalization	1	.035	.852	.000
	Contextualization	1	.507	.478	.004
	Interaction	1	.042	.837	.000
	Error	120			

A third method for capturing cognitive load, a nine point mental effort scale, encouraged participants to rank the amount of mental effort they were exuding while learning and using the new target lexical items during the multimedia tutorial and during the fill-in-the-blank posttest.

Participants ranked themselves for mental effort on a continuum from 1, low mental effort, to 9, high mental effort, at three locations both during the tutorial and during the fill-in-the-blank posttest instrument. These three rankings were combined to form a mental effort total score out of 27 possible points on both the tutorial and the posttest respectively. The mean results of these rankings are reflected in Table 21.

Table 21

Mental Effort Rankings: Multimedia Tutorial and Fill-in-the-Blank Posttest

		Treatment				
Instrument		Personalized-Contextualized	Personalized-Decontextualized	Generic-Contextualized	Generic-Decontextualized	Total
Tutorial	*M*	13.87	16.52	15.30	14.34	15.01
	SD	4.91	4.57	5.99	5.10	5.14
	n	30	30	33	33	126
Fill-in-the-Blank Posttest	*M*	20.24	21.29	23.49	21.19	21.55
	SD	4.89	4.56	4.12	5.95	4.88
	n	31	29	33	29	122

These mental effort total scores were subjected to a 2 X 2 between subjects ANOVA in order to uncover possible differences across treatment groups. The results of these analyses, by instrument, are presented in Table 22.

Table 22

Main Effects of Mental Effort Measured in the Tutorial and Fill-in Posttest

Instrument	**Factor**	**df**	***F***	***p***	η_p^2
Tutorial	Personalization	1	.160	.690	.001
	Contextualization	1	.831	.364	.007
	Interaction	1	3.807	.053	.030
	Error	122			
Fill-in-the-Blank Posttest	Personalization	1	3.121	.080	.026
	Contextualization	1	.490	.485	.004
	Interaction	1	3.546	.062	.029
	Error	118			

Table 22 indicates an interaction effect that approaches significance between personalization and contextualization, on the amount of mental effort that learners exuded during the multimedia lexicon tutorial, $F(1, 122) = 3.817$, $p = .053$, $\eta_p^2 = .030$. Despite the small effect size, this finding may suggest that learners who were presented with a personalized and contextualized tutorial presentation ranked themselves as expending less mental effort (M = 13.867, SD = 4.91, n = 30) than the learners presented with a personalized and decontextualized multimedia tutorial presentation (M = 16.517, SD = 4.57, n = 30). By the same token, learners who received a generic-decontextualized tutorial ranked themselves as expending less mental effort (M = 14.341, SD = 5.10, n = 33) than did their generic-contextualized contemporaries (M = 15.303, SD = 5.99, n = 33).

When considering the written fill-in-the-blank posttest, Table 22 also suggests a main interaction effect that approaches significance, $F(1, 118) = 3.55$, $p = .062$, $\eta_p^2 = .029$. Although the effect size is small, this finding may suggest that participants who received a personalized-contextualized tutorial might have exuded less mental effort during the fill-in task (M = 20.242, SD = 4.889, n = 31) than did their colleagues who received a personalized-decontextualized tutorial (*M* = 21.293, SD = 4.556, *n* = 29). Additionally, those who received a generic-decontextualized tutorial (*M* = 21.190, *SD* = 5.954, *n* = 29) may have exuded less cognitive effort than their generic-contextualized (*M* = 23.485, SD = 4.116, *n* = 33) colleagues.

Finally, Table 22 also demonstrates a trend toward the possible effect of personalization on learners' mental effort, $F(1, 118) = 3.121$, $p = .080$, $\eta_p^2 = .026$. Although the finding is not significant, the results suggest that perhaps learners who received personalized tutorials (*M* = 20.750, SD = 4.721, *n* = 60) saw it necessary to expend slightly less mental effort than learners who received generic tutorials (*M* = 22.411, SD = 5.147, *n* = 62).

Research Question 3: Motivation

The study's final research question sought to determine how presenting the learner with personalized and/or contextualized learning materials might affect motivation for learning the target family relationship lexical items. After completing the multimedia tutorial, participants ranked themselves on a 100- point scale from 0, the lesson was demotivating, for example, to 100, the lesson was motivating. The results of the learners' rankings are housed in Table 23.

Table 23

Mean Score for Motivation Following Multimedia Tutorial by Treatment

Instrument		Treatment			
		Personalized-Contextualized	Personalized-Decontextualized	Generic-Contextualized	Generic-Decontextualized
Slow(0)→ Fast(100)	*M*	50.65	50.53	47.79	55.06
	SD	16.42	12.13	19.20	19.32
	n	31	30	34	33
Dull(0)→ Interesting (100)	*M*	63.32	61.60	51.32	57.64
	SD	21.15	20.01	24.90	20.42
	n	31	30	34	33
Easy(0)→ Hard(100)	*M*	38.87	36.33	31.91	28.88
	SD	24.07	21.77	28.92	20.42
	n	31	30	34	33
Boring(0)→ Fun(100)	*M*	62.42	55.67	46.47	51.49
	SD	23.38	20.31	26.13	21.58
	n	31	30	34	33
Passive(0)→ Active (100)	*M*	61.23	55.90	59.56	55.30
	SD	23.16	18.64	23.30	22.30
	n	31	30	34	33
Irrelevant (0)→ Relevant (100)	*M*	87.26	81.80	80.59	85.52
	SD	14.07	16.27	23.18	14.98
	n	31	30	34	33
Light(0)→ Heavy(100)	*M*	44.19	40.63	44.41	41.67
	SD	18.89	23.33	24.73	17.44
	n	31	30	34	33
Demotivat-ing(0) → Motivating (100)	*M*	74.36	66.67	66.38	69.82
	SD	19.18	16.88	25.19	15.69
	n	31	30	34	33
Lesson was more **understand-able** than in other units: disagree(0)→ agree(100)	*M*	66.84	68.47	64.06	64.68
	SD	21.41	21.40	24.44	21.48
	n	31	30	34	31

Table 23 Continued

Lesson was more **enjoyable** than other units: strongly disagree(0)→ strongly agree(100)	*M* *SD* *n*	58.90 25.74 31	56.67 21.43 30	57.32 24.40 34	55.39 21.98 31
Terms were **easier to remember** than in other units: strongly disagree(0)→ strongly agree(100)	*M* *SD* *n*	63.97 23.78 31	67.17 24.13 30	63.35 25.99 34	61.94 22.31 31
Lesson put learner **in the problem situation**: strongly disagree(0)→ strongly agree(100)	*M* *SD* *n*	45.39 34.58 31	40.73 26.75 30	43.52 32.57 33	43.13 25.77 30
Instruction **held the learner's attention**: strongly disagree(0)→ strongly agree(100)	*M* *SD* *n*	74.36 22.09 31	64.97 23.75 30	68.68 25.92 34	67.71 20.07 31

Each scale was subjected to a 2 (personalized/generic) X 2 (contextualized/decontextualized) between subjects factorial ANOVA to determine differences in motivational sentiment across treatments. The results are reflected in Table 24.

Table 24

Main Effects of Measures of Motivation Across Treatments Following Multimedia Tutorial

Instrument	**Factor**	**df**	***F***	***p***	η_p^2
Slow(0)→Fast(100)	Personalization	1	.076	.783	.001
	Contextualization	1	1.390	.241	.011
	Interaction	1	1.478	.226	.012
	Error	124			
Dull(0)→Interesting(100)	Personalization	1	4.285	.041*	.033
	Contextualization	1	.354	.553	.003
	Interaction	1	1.086	.299	.009
	Error	124			
Easy(0)→Hard(100)	Personalization	1	2.853	.094	.022
	Contextualization	1	.426	.515	.003
	Interaction	1	.003	.954	.000
	Error	124			
Boring(0)→Fun(100)	Personalization	1	6.096	.015*	.047
	Contextualization	1	.045	.832	.000
	Interaction	1	2.083	.151	.017
	Error	124			
Passive(0)→Active(100)	Personalization	1	.085	.772	.001
	Contextualization	1	1.514	.221	.012
	Interaction	1	.019	.891	.000
	Error	124			
Irrelevant(0)→ Relevant(100)	Personalization	1	.224	.637	.002
	Contextualization	1	.007	.932	.000
	Interaction	1	2.769	.099	.022
	Error	124			
Light(0)→Heavy(100)	Personalization	1	.027	.869	.000
	Contextualization	1	.697	.405	.006
	Interaction	1	.012	.914	.000
	Error	124			
Demotivating(0)→ Motivating(100)	Personalization	1	.478	.491	.004
	Contextualization	1	.372	.543	.003
	Interaction	1	2.545	.113	.020
	Error	124			

Table 24 Continued

Lesson was more **understandable** than in other units: strongly disagree(0)→strongly agree(100)	Personalization	1	.683	.410	.006
	Contextualization	1	.080	.778	.001
	Interaction	1	.016	.899	.000
	Error	122			
Lesson was more **enjoyable** than other units: strongly disagree(0)→strongly agree(100)	Personalization	1	.116	.734	.001
	Contextualization	1	.248	.619	.002
	Interaction	1	.001	.971	.000
	Error	122			
Terms were **easier to remember** than in other units: strongly disagree(0)→strongly agree(100)	Personalization	1	.461	.498	.004
	Contextualization	1	.043	.836	.000
	Interaction	1	.287	.593	.002
	Error	122			
Lesson put learner **in the problem situation**: strongly disagree(0)→strongly agree(100)	Personalization	1	.002	.961	.000
	Contextualization	1	.214	.644	.002
	Interaction	1	.154	.695	.001
	Error	120			
Instruction **held the learner's attention**: strongly disagree(0)→strongly agree(100)	Personalization	1	.127	.723	.001
	Contextualization	1	1.576	.212	.013
	Interaction	1	1.042	.309	.008
	Error	122			

Note. * Denotes a significant effect at $p < .05$.

The results presented in Table 24 indicate that participants who received a personalized multimedia tutorial were more *interested* in the learning environment (M = 62.475, SD = 20.44, n = 61), than the participants who received a generic multimedia presentation (M = 54.433, SD = 22.85, n = 67). This significant personalization effect is reflected in Figure 6.

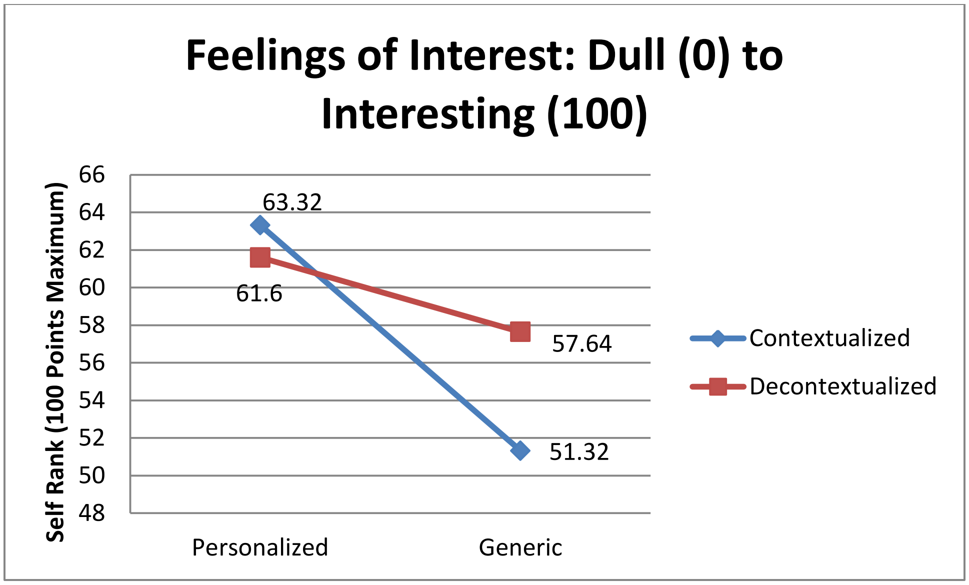

Figure 6. Significant effect of personalization for learners' self-rankings of *interest* after completing the multimedia tutorial.

Additionally, learners felt that personalized tutorials (*M* = 59.098, *SD* = 22.00, *n* = 61) were more *enjoyable* (i.e., more fun) than generic non-personalized tutorials (*M* = 48.940, *SD* = 23.95, *n* = 67), as reflected in Figure 7.

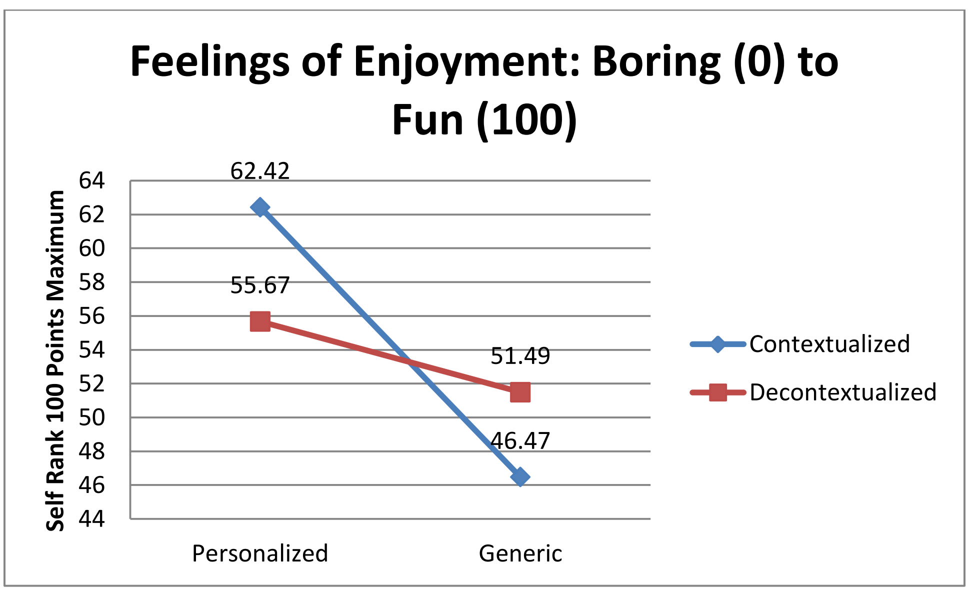

Figure 7. Significant effect of personalization for learners' self-rankings of *enjoyment* after completing the multimedia tutorial.

Although other results were not significant, the analyses revealed that learners receiving a personalized multimedia presentation approached a significant main effect for difficulty. In this case, personalized learners' self-rankings for difficulty (*M* = 37.62, *SD* = 22.81, *n* = 61) approached a significant main effect when compared to learners who received a generic multimedia presentation (*M* = 30.418, *SD* = 24.95, *n* = 67), with personalized learners ranking the tutorial more difficult than generic learners. By the same token, an interaction main effect for relevance of the learning environment reflected results that approached significance. Learners who received a personalized and contextualized tutorial (*M* = 87.26, *SD* = 14.07, *n* = 31) may have found the tutorial more relevant than did their personalized and decontextualized counterparts (*M* = 81.80, *SD* = 16.27, *n* = 30). Learners who received a generic and decontextualized tutorial (*M* = 85.52, *SD* = 14.98, *n* = 33) seemed to find the new learning environment to be more germane (relevant) to learning the target lexical terms than did their generic and contextualized counterparts (*M* = 80.588, *SD* = 23.18, *n* = 34).

In summary, the study's analyses returned predominately-insignificant results; however, each research question did give rise to significant findings. These significant results were primarily centered around the interaction effect between personalization and contextualization. When considering retention and transfer, the interaction effect was manifested, but only on the problem-solving transfer task where personalized-contextualized and generic-decontextualized learners performed significantly better than their personalized-decontextualized and generic-contextualized counterparts. Other retention and transfer effects were not significant. The main interaction effect for personalization and contextualization also emerged when considering cognitive load. Again, learners in the personalized-contextualized and generic-decontextualized treatments exuded less cognitive resources when considering *task demands* (thinking, deciding, calculating, remembering, looking, searching, etc.) than their personalized-decontextualized and generic-contextualized contemporaries when faced with a fill-in-the-blank transfer task. The interaction effect also varied in the same direction when considering a main effect for *feelings of success*. Personalized-contextualized and generic-decontextualized learners felt themselves more successful when learning the target family relationship lexical terms after the tutorial and when recalling those terms after the free-recall retention task than did their personalized-decontextualized and generic-contextualized companions. However, the significant personalized and contextualized interaction effect trend did not carry over into measures of motivation. No motivational interaction effect proved significant although an interaction effect for *relevance of the learning environment* approached significance. Nevertheless, measures of motivation did significantly support the idea that personalization has an effect on learners' engagement. Learners receiving a personalized tutorial found their learning environment significantly more *interesting* and more *fun* than did their generic learning environment counterparts.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

The purpose of the study was to determine the effect of personalizing and contextualizing foreign language lexical instruction. Specifically, the study aimed to determine how a personalized and highly contextualized multimedia tutorial would affect achievement (retention and transfer of the target lexical items), cognitive load experienced while learning and while using the new lexicon, and motivation for learning the target lexical items. The discussion now seeks to interpret the reported results by research question, as well as provide recommendations for future research and suggest possible practical pedagogical implications of the study.

Retention and Transfer

The first research question aimed to determine how learners' abilities to both retain and transfer target lexical items might be influenced by the learning environment's level of personalization and contextualization. The results indicated that neither personalizing nor contextualizing the learning environment significantly improved learners' lexical retention performance on the free-recall post-test, nor was transfer improved on the fill-in-the-blank post-test task, nor the problem-solving task. However a combination of personalized and contextualized lessons proved more effective than personalized and decontextualized lessons on the problem-solving task, suggesting that when facing a complex task and when learners' lesson plans are personalized and catered to them, augmenting this level of personalization through the addition of contextualizing details might prove more effective than withholding extra detail. By the same token, when learners' lesson plans are generic, less contextualizing detail is actually more effective than including details that allocate the target lexical terms within a meaningful context.

Improving the effectiveness of instruction by stripping a generic lesson of contextualizing details falls in-line with cognitive load research. Researchers suggest that that learners are easily overwhelmed by complex new material, especially when new material is highly contextualized in an attempt to mimic authentic or real-life situations, and when the learner must make meaning out of these new forms, as in a problem-solving activity (Kirschner et al., 2006; Sweller, 1988; VanPatten, 1990). Specifically, when learners are solving complex problems, personalization research suggests that learners can save on cognitive resources when the problem involves items for which learners have already established a schema (Symons & Johnson, 1997). Having mental structures already in place for the elements that make up the problem space allows learners to have the mental resources needed to solve the problem and learn from its solving (Cooper et al., 2001; Kalyuga et al., 2001; Tuovinen & Sweller, 1999). Learners who are presented with new lexical items through a generic multimedia lesson have no script for the generic images/names placed before them, and thus find themselves obligated to dedicate cognitive resources to the processing of these new images. This extraneous processing of unfamiliar generic visual material may leave little cognitive resources for processing contextualizing details that would bind a new lexical term within a family of like terms. Foreign language lexical acquisition research has a propensity for advocating the inclusion of rich contextualizing details for each new target term in order to facilitate learners' ability to map or bind the target term within a meaningful family of like terms (Johnson & Pearson, 1978; Morin & Goebel, 2001). Nevertheless, this study suggests that while this prescription may improve performance for learners faced with a personalized lesson for which they already have mental structures in place, perhaps augmenting contextualizing details will prove less effective for learners faced with generic (non-personalized) learning environments. The fact that these differences only appeared in the problem-solving task may suggest that gaps in learning caused by the extraneous processing of complex contextualizing details may only emerge when learners are faced with tasks that require learners to holistically consider multiple new elements at once, such as in the problem-solving task posttest.

Cognitive Load

The second question of the study wanted to determine how personalization and contextualization might influence learners' perceived feelings of cognitive load while learning and using the new target lexical items. The non-significant results for working load as measured by calculating the mean score of the first three items of the adapted version of the NASA TLX instrument (i.e., task demands—mental activity, mental effort, and navigational demands respectively) indicated that learners could not see themselves as significantly improved by their assigned treatments when ranking themselves for the amount of working load exuded during the tutorial, nor during the post-test tasks. When considering mental effort and navigational demands individually, the results indicated that presenting learners with personalized lessons did not necessarily make any one particular group feel like less mental activity and effort were required to accomplish their mandated tasks in Spanish. Moreover, nor did one group of learners self-identify as feeling more mental stress than another when completing their required tasks. However, the NASA TLX instrument did indicate that learners in the personalized-contextualized group and the generic-decontextualized group felt as though they exuded less mental activity (i.e., task demands) than did their personalized-decontextualized and generic-contextualized contemporaries respectively, when tackling the fill-in-the-blank transfer task. Additionally, the same ameliorating main effects of personalization and contextualization emerged when learners ranked themselves for *success.* Learners in the personalized-contextualized and generic-decontextualized groups felt more successful during the tutorial and free recall post-test task than did their personalized-decontextualized and generic-contextualized counterparts. The positive interaction effects dwindled as the posttest tasks became more complex and results merely approached significance when learners completed the fill-in-the-blank transfer task and no significance was found across groups when learners completed the posttest problem-solving task.

Once again, here we see that learners who were presented with their new lexical knowledge structures through personalized and contextualized lesson plans were able to expend less mental activity when later transferring this new knowledge to a novel environment than learners who saw their personalized lesson plans stripped of rich contextualizing detail. By the same token, learners who were presented with a generic learning environment utilized less mental effort in transferring that knowledge, when they learned through a decontextualized environment as opposed to a contextualized one. Thus, again we see that personalization is variably effected by contextualization. Personalized learners benefit from rich contextualizing detail and generic learners are hampered by extra detail. These findings again fall in line with previous research. Researchers suggest that highly contextualized and authentic environments can make learning more meaningful for learners (Bransford & Johnson, 1972; Sadoski, Goetz, & Fritz, 1993; Shrum & Glisan, 2005). However, highly contextualized environments are seen by many cognitive load researchers as too complex for novice learners (Kirschner et al., 2006; Sweller et al., 2011; van Merriënboer et al., 2003). In this case, the respective ameliorating and pejorative effects of contextualized learning environments are mitigated through personalized lessons that serve to bolster learning by reducing the intrinsic cognitive load of the target learning domain (Anand & Ross, 1987; Davis-Dorsey et al., 1991; Herndon, 1987; Lopez, 1990;

Moreno & Mayer, 2000; Ross, 1983; Ross & Anand, 1987; Ross et al., 1985; Ross et al., 1986). It holds then that when learners are dropped into an unfamiliar (or generic) learning environment, cognitive resources must first be spent to process the learning environment (i.e., problem space creation), and therefore the addition of contextualizing details might outpace learners' abilities to process them, causing cognitive overload and a breakdown in learning (Cooper et al., 2001; Kalyuga et al., 2001; Tuovinen & Sweller, 1999).

Personalized-contextualized and generic-decontextualized learners also were more likely to feel successful during learning and recalling their knowledge than their personalized-decontextualized and generic-contextualized counterparts. Learners in the personalized-contextualized treatment perhaps felt a surge of confidence when they saw their own families and context about those families reflected in the tutorial's learning materials, with the positive effects of both context and personalization contributing to learners' feelings of success (Anand & Ross, 1987; Bransford & Johnson, 1972; Davis-Dorsey et al., 1991; Herndon, 1987; Lopez, 1990; Moreno & Mayer, 2000; Ross, 1983; Ross & Anand, 1987; Ross et al., 1985; Ross et al., 1986; Sadoski et al., 1993; Shrum & Glisan, 2005). By the same token, those who were met with an unfamiliar (generic) family may have taken comfort in and drawn confidence from the simplistic nature of a generic presentation bereft of complicating context, which served to bolster their perceptions of success (Kirschner et al., 2006; Sweller et al., 2011; van Merriënboer et al., 2003). However, as the tasks became complex in the transfer tasks, these elevated feelings of success began to deplete and learners across groups began to feel equal regarding their feelings of success, with no one group ranking itself significantly more successful than another

In addition to the NASA TLX instrument, total time on task was measured during the fill-in-the-blank post-test task and during the problem-solving post-test task. All time on task findings were insignificant. Some research suggested that greater time spent on a task might indicate that greater cognitive load was exuded during the task and that time therefore might be used as an objective measure of cognitive load (Chandler & Sweller, 1991, 1992; van Gog & Paas, 2008). In this case, no one treatment proved to spend significantly less time than any other on the tasks that lent themselves to an elapsed time measurement of this variety.

The more localized measures of mental effort, using the nine-point mental effort scale (see Appendix L) within the tutorial and the fill-in-the-blank transfer task also proved insignificant. An interaction effect approached significance on both the tutorial and fill-in-the-blank task, with, once again, personalized-contextualized learners expending the least amount of mental effort, when compared to the other treatment groups. As shown above when considering the adapted NASA TLX task demands metric, learners ranking themselves for *mental effort* may have benefited from the cognitive load reducing effects of the personalized treatment as well as the possible learning benefits suggested by a contextualized environment (Anand & Ross, 1987; Bransford & Johnson, 1972; Davis-Dorsey et al., 1991; Herndon, 1987; Lopez, 1990; Moreno & Mayer, 2000; Ross, 1983; Ross & Anand, 1987; Ross et al., 1985; Ross et al., 1986; Sadoski et al., 1993; Shrum & Glisan, 2005). However, with a small effect size and values that only approach significance, the study might conclude that these personalized-contextualized interaction effects are negligible for reducing mental effort in these transfer tasks.

Motivation

The final research goal of the study sought to determine how varied levels of personalization and contextualization might affect learners' motivation for acquiring the target family relationship lexical items. The motivation for learning survey was completed by participants directly following the multimedia tutorial (Ross, 1983; Ross & Anand, 1987). Table

24 reflects the primarily insignificant results; however, the table does reflect that learners who received a personalized multimedia tutorial were more *interested* in the learning environment than those who received a generic presentation. Additionally, personalized learners felt that their multimedia tutorials were more *fun* than their generic multimedia tutorial contemporaries. These findings are in keeping with personalization research which finds that personalized lesson plans reliably show improved interest and motivation for learning (Anand & Ross, 1987; Davis-Dorsey et al., 1991; Ginns et al., 2013; Herndon, 1987; Kartal, 2010; Lopez, 1990; Mayer et al., 2004; Moreno & Mayer, 2000; Moreno & Mayer, 2004; Ross, 1983; Ross & Anand, 1987; Ross et al., 1985; Ross et al., 1986).

It should be mentioned however that when learners were asked directly about whether their tutorial was *motivating* or *demotivating* personalized learners were no more likely than their generic learner counterparts to label their multimedia tutorial *motivating*. In fact, puzzling results that approached significance showed that personalized learners may have felt that their tutorial was more *difficult* than their companions who were subjected to a generic learning environment. One explanation for these findings might reside in the fact that personalized lesson content might distract the learner from the learning task. Might it be possible that learners have *too great* of a schema for some of the personalized content presented in the learning environment, such that the schema provides seductive details that distract from the learning task at hand? Some research suggests that seductive details, or details that are not germane to the topic at hand, can result in extraneous processing, distracting learners from the target topic, and that these extraneous details may lead to poorer recall (Garner, Gillingham, & White, 1989; Harp & Mayer, 1998).

Finally, it should also be noted that the measure of *relevance* also approached significance. Table 24 shows that a personalization and contextualization interaction approached significance which indicated that learners subjected to a personalized-contextualized and a generic-decontextualized tutorial may have ranked their learning environments more *relevant* than their respective personalized-decontextualized and generic-contextualized counterparts. Perhaps allocating a personalized lesson within a rich personalized context seemed more relevant than including a personalized family pedigree and withholding the necessary contextualizing details needed to nestle the personalized content within the real-life family tree. By the same token, perhaps stripping contextualizing details from a generic pedigree seemed more relevant and natural for learners than forcing an authentic context in a generic family relationships learning environment.

Recommendations

The current study affords various opportunities for future research. First, future research would do well to consider the possible interaction between personalized and contextualized learning material. This study suggests that an interaction exists between these variables that influences achievement, cognitive load, and learners' feelings of perceived success.

The study's finding suggest that learners presented with personalized lessons benefit even further when these lessons are placed within a rich context of surrounding details when attempting to transfer their knowledge to a new task. However, by the same token, when learners are faced with a generic learning environment, they are able to transfer their knowledge best when the environment is left bereft of supportive contextualized details. Future studies might seek to further this finding by explaining to what degree personalized lessons can be improved by the addition of contextualizing details. Moreover, future investigators might seek to determine whether these findings only hold in a transfer context or might rich context *and* personalization also improve retention tasks.

Personalization and contextualization also had an effect on learners' perceived feelings of cognitive load related to task demands (thinking, deciding, calculating, remembering, looking, searching, etc.). As previous researchers have been critical of the role of highly contextualized environments for novice learners (Kirschner et al., 2006; Sweller et al., 2011; van Merriënboer et al., 2003), future research projects might seek to determine what mitigating effects personalization might play for reducing cognitive load, such that contextualizing details might have an ameliorating effect on cognitive load reduction and learning without outpacing learners' cognitive resources.

Finally, a personalization-contextualization interaction effect also surfaced with regards to learners' perceived feelings of success, both during the tutorial and after the tutorial, when engaged in the free recall task. Future research might seek to determine why learners faced with augmented context and personalization feel more successful than they do when faced with decreased context and personalization. Moreover, a future study might seek to discover why feelings of success are higher when generic lessons are stripped of context compared to when generic lessons are rich in contextualized details.

Although the connection between personalization and learner engagement has already been established in the literature, future research might also seek to forge a more precise link between personalization and motivation. For example, the current study showed that personalized lesson plans were more interesting and more fun for learners; this finding might be extended by future research that could discover to what degree lessons must be personalized in order to improve student interest. Learners might be significantly more engaged and invested in the learning environment when family photos are used instead of simply employing family names in the learning materials, for example. Additionally, future research might explore further the role of incentives provided to participants. The current study utilized an extrinsic motivator, a cash reward, in order to motivate learners to acquire target terms. Future research might seek to measure how such incentives influence the outcome of instruments that seek to measure participants' motivation for learning. Similarly, future studies might even choose to eliminate possibly confounding extrinsic motivators completely.

Most results in this study proved insignificant, perhaps due to the subject matter that was utilized during the study. Some researchers suggest that learners engaged in acquiring foreign language lexicon are able to serialize their learning, considering each new lexical item as an individual element of knowledge and thus avoid complex interacting elements (Sweller et al., 2011). The current topic, family relationships lexical items, was selected primarily to avoid such *ad hoc* strategies employed by learners, due to the fact that each new lexical item was thought to be intimately connected to the other previously presented items. However, perhaps future cognitive load studies would do well to apply personalized/generic and contextualized/decontextualized treatments to more traditional cognitive load heavy environments, such as mathematics, science, second language grammar lessons, or other subject matters in which it would prove impossible for learners to apply, whether consciously or subconsciously, individually unique decontextualization strategies (e.g., serialization).

Moreover, foreign and second language lexical acquisition studies would do well to substantiate further the idea purported in this study, that certain lexical terms and topics cannot be fully acquired without first considering the surrounding family of like-terms that learners must sort through in order to derive their meaning. From both cognitive load research and second language acquisition research perspectives, if lexical items are employed, future studies would do well to utilize a think-aloud-protocol methodology during instructional interventions in order to determine whether learners may be using strategies beyond those anticipated by the study's instructional treatments to enhance or otherwise supplement their acquisition of the target lexical terms. A think-aloud-protocol might improve the strength of foreign language lexical studies by corroborating that variances in scores across intervention groups are due to instructional prescriptions and not due to *ad hoc* learning strategies that may or may not be employed idiosyncratically by individual learners, regardless of their randomly assigned treatment.

Although in the current study data showed only a significant trend, future research might do well to explore the relationship between augmented personalization and the perception of augmented difficulty. Although significance was not reached, learners in the current study may have felt that personalized learning materials were more difficult than generic materials. Further studies might seek to explore ways in which personalization might decrease learners' feelings of perceived effectiveness both within and without the domain of foreign language lexical learning.

Finally, future studies might do well to consider personalization level. If personalized lesson plans are more engaging for learners, how much personalization is helpful? For example, should learning materials contain personalized text and pictures as in the current study, or would personalized text alone be just as effective? Consider, in the current study, learners were presented with personalized pictures of family members and each family member's name written in text, both of which were linked with text and audio narrations that forged a relationship between their family member and the new target lexical term. Perhaps learners would be just as well served or better served by personalized lessons that utilized only textual names, or only visual pictures. Employing only text or only pictures would reduce the time needed to personalize lesson plans for each learner, making learning materials of this nature more practical.

Similarly, future research might also consider treatments that employ a mixture of personalized and generic content. For example, if technologies emerge that make feasible the widespread application of personalized lesson content based on learners' own uploaded materials, what might be done for learners who cannot upload as much personalized content as their contemporaries? For example, in the current study, some learners did not upload a completed family pedigree chart as instructed (e.g., they did not have a sister). In such cases, perhaps learners would need to have their personalized instruction supplemented by generic content. Personalization research, if it is to be widely applied, would do well to investigate the effect of the presence of both personalized and generic content within the same lesson.

Implications

The results of the study imply that learners faced with problem-solving tasks may benefit from varied levels of personalization and contextualization of the learning materials. Although learners are not benefited by personalized and contextualized learning contexts when recalling target lexical items and when filling-in blanks with these items, learners may very well benefit from augmenting a personalized lesson with contextualized detail when faced with a problem-solving task that requires learners to holistically apply their new lexical knowledge. Problem-solving tasks are often heavy in cognitive load and personalized-contextualized learning materials can improve achievement when learners are faced with such tasks. By the same token, when learners are faced with generic learning environments, instructors should strip these environments of extraneous contextualizing detail so as to not distract the learner or complicate the generic lesson plan further.

Instructors who teach topics heavy in cognitive load might also do well to consider utilizing methods to personalize and contextualize their lesson plans, especially when the knowledge acquired about these topics must be transferred to new or unrelated tasks. The current study showed that when learners were transferring their new knowledge to new tasks, personalization *and* contextualization helped reduce their mental effort. By the same token, instructors who do not have the resources available to them to personalize content should employ learning materials that are bereft of contextualizing details. Making complex tasks more palatable to learners through these tactics may ensure that they succeed when applying their new knowledge to new authentic environments. Likewise, learners who see their personalized lesson plans enriched with contextualized details may feel more confidence when tackling learning outcomes that are heavy in cognitive load. This study suggests that learners felt more successful in learning and recalling target new knowledge when they learned through personalized-contextualized materials and through generic-decontextualized materials. Furthermore, when instructors are not able to personalize lesson plans, learners may feel more successful by stripping generic lessons of any complicating contextualizing details.

Finally, instructors who struggle with making the learning environment engaging might also benefit from personalizing the learning environment to each learner. The study shows that learners who enjoy a personalized learning environment will be more interested, and find the environment for learning more fun, even if they find the environment more challenging. Additionally, learners who see their lessons enriched with contextualizing detail may see their learning environment as more relevant. Likewise, if instructors are not able to personalize lesson plans, due to time constraints, for example, they can perhaps make generic lessons more relevant by not forcing contextualizing detail in these generic environments but leaving the lesson materials free of contextualization.

Although personalization can have ameliorating effects on transfer task problem solving performance, cognitive load, and learner engagement, instructors need to consider carefully whether gains in these areas are so highly desired that they offset the additional preparation time required by a personalization paradigm. Personalizing lesson plans for learners can be very time consuming. In the current study, learners were tasked with acquiring 22 family relationship lexical items and personalizing these lessons only affected achievement on one of the three posttest tasks, the problem-solving task. Personalizing a lesson plan required 30 minutes of extra lesson planning effort per learner with only a moderate achievement advantage demonstrated by learners affected by such efforts. This study suggests that personalizing lessons and including extra context likely is not worth the extra lesson development time that would be required for learners, at least within the domain of foreign language lexical learning. That is not to say that personalized-contextualized lesson materials should be abandoned altogether.

Advances in adaptive computer technologies, intelligent tutoring systems, and artificial intelligence may soon make personalized instruction practical for the day-to-day classroom. For example, tomorrow's educational technologies may be able to automatize the creation of personalized instruction by pulling material from a survey that students are instructed to complete at the onset of each semester, unit, or chapter. Personalized content culled from such surveys would serve as the basis for the automatic creation of a lesson plan that is completely catered to the individual learner's achievement level and personal interests. As these technologies advance, educational content publishers that already employ adaptive computer technologies to deliver just-in-time assessments that cater instruction to meet a learner's *level* of achievement, may soon be able to personalize learning to fit more fully the students' interests, motivations, and values as well. Soon, without any added effort, perhaps educators, will be able enjoy augmented lesson materials such as personalized and highly contextualized lesson plans that are practically embedded within the curriculum. Until then, given limited technological resources, practitioners would do well to focus only on personalizing lessons that house learning objectives deemed heaviest in cognitive load, where personalization can be maximally effective.

Conclusions

The results of this study suggest that learners can improve their ability to solve complex problems that utilize their new knowledge structures by learning through highly personalized and contextualized environments. Moreover, learners who are presented with generic learning environments perform best when these environments are stripped of complicating contextualized details. Personalization and contextualization do not significantly improve achievement when learners are meant to simply recall information or utilize their learning for discrete point transfer tasks, such as fill-in-the-blank exercises.

Working load is not significantly reduced by personalizing and contextualizing lesson materials. However, mental activity (task demands) expended by the learner can be reduced through personalizing and contextualizing the learning environment as well as decontextualizing generic learning environments. A similar effect is seen when learners rank their feelings of success when learning and recalling the new lexical material. The study shows that learners might gain greater feelings of success for learning a complex target topic when their learning materials are presented to them through either a highly contextualized-personalized environment and/or through generic environments that are stripped of contextualizing details.

Personalization can also be affectively beneficial. Learners felt that personalized lessons were more interesting than did learners who were faced with generic instructional materials. Likewise, learners who received personalized lesson content also ranked their learning more fun than their contemporaries who received non-personalized lesson plans.

Finally, all gains demonstrated by augmented lesson materials (personalization-contextualization) may be seen as marginal when compared with the vast amount of effort required to develop these lessons. On average, personalized lesson materials required 30 minutes of additional preparation time per learner, making the benefits demonstrated by learners who enjoyed personalized lessons seem marginal, especially when considered in light of the inordinate amount of time needed for lesson development that was required by a personalized instructional material paradigm. However, the beneficial effects of personalization may become more practically implemented in the future as adaptive computer technologies become more fully integrated within educational systems.

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Appendix A

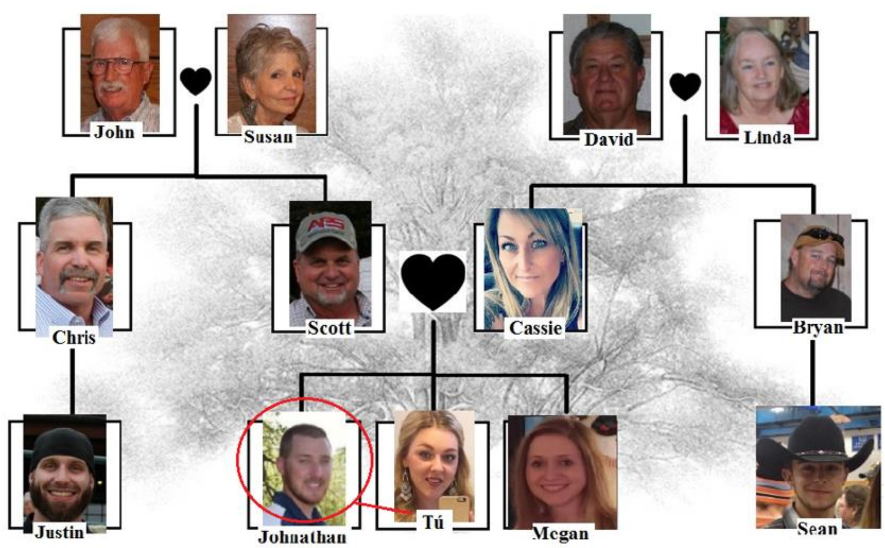
Lexical Items Presented in the Multimedia Tutorial

	English	Spanish
1.	grandfather	abuelo
2.	grandmother	abuela
3.	father	padre
4.	mother	madre
5.	son	hijo
6.	daughter	hija
7.	brother	hermano
8.	sister	hermana
9.	uncle	tío
10.	aunt	tía
11.	nephew	sobrino
12.	niece	sobrina
13.	cousin (male)	primo
14.	cousin (female)	prima
15.	brother-in-law	cuñado
16.	sister-in-law	cuñada
17.	father-in-law	suegro
18.	mother-in-law	suegra
19.	son-in-law	yerno
20.	daughter-in-law	nuera
21.	grandson	nieto
22.	granddaughter	nieta

Appendix B

Treatment 1-Personalized/Contextualized

Sample Material from Treatment One's Multimedia Tutorial Presentation (Personalized-Contextualized)

Screen Shot from Tutorial	Audio Script from Tutorial
	Explanatory Audio Narration: *Tú eres la hija de tu padre. Él es el hijo de tu padre. Él es tu* hermano. (*You are the daughter of your father. He is the son of your father. He is your* brother.)

Appendix C

Treatment 2-Personalized/Decontextualized

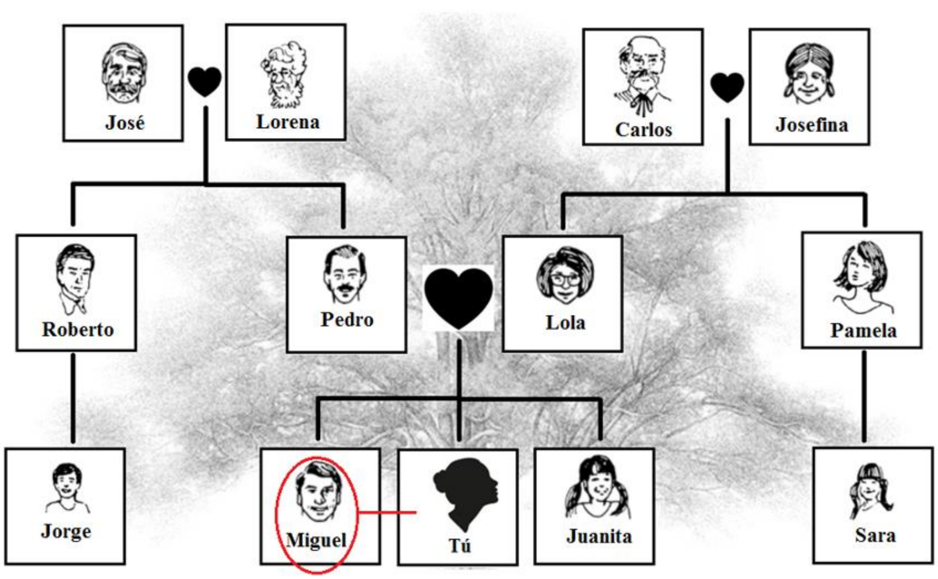
Sample Material from Treatment Two's Multimedia Tutorial Presentation (Personalized-Decontextualized)

Screen Shot from Tutorial	Audio Script from Tutorial
	Explanatory Audio Narration : *Él es tu hermano.* (*He is your brother*).

Appendix D

Treatment 3-Generic/Contextualized

Sample Material from Treatment Three's Multimedia Tutorial Presentation (Generic-Contextualized)

Screen Shot from Tutorial	Audio Script from Tutorial
	Explanatory Audio Narration: *Tú eres la hija de tu padre. Miguel es el hijo de tu padre. Miguel es tu* hermano. (*You are the daughter of your father. Miguel is the son of your father. Miguel is your* brother.)

Appendix E

Treatment 4-Generic/Decontextualized

Sample Material from Treatment Four's Multimedia Tutorial Presentation (Generic-Decontextualized)

Screen Shot from Tutorial-Generic/Decontextualized	Audio Script from Tutorial
	Explanatory Audio Narration: *Miguel es tu hermano.* (*Miguel is your brother*).

Appendix F

Explanatory Audio for All Treatments

Slide with Visual Text of Target Term and Explanatory Audio Narration Presented to All Treatments

Screen Shot from Tutorial	Audio Script from Tutorial
hermano	Explanatory Audio Narration : Hermano *es "brother" en inglés.* (Hermano *is "brother" in English*).

Appendix G

Demographic Survey

1. What is your name? (For tracking purposes only; names will not be included in research findings)

First:	Middle:	Last:

2. What is your gender?

A. Male	B. Female

3. What is your age?

A. Under 15 years old	B. 15-17 years old	C. 18-24 years old	D. 25-34 years old
E. 35-44 years old	F. 45-54 years old	G. 55 years or older	

4. Race/Ethnicity: How do you describe yourself?

A. American Indian or Alaska Native	B. Hawaiian or Other Pacific Islander	C. Asian or Asian American	D. Black or African American	E. Hispanic or Latino	F. Non-Hispanic White	G. Other

5. What is your year in college?

A. Freshman	B. Sophomore	C. Junior	D. Senior	E. Graduate school	F. Already graduated, taking classes for personal enrichment

6. What is your major?

____

7. How many semesters of Spanish have you taken in high school **AND** college (one year of high school Spanish = two semesters)?

____

Appendix H

Spanish Familial Relationships Prior Knowledge Pretest

Instructions: Write the Spanish equivalent in the right column of the English family term in the left column.

	English	Spanish
1.	grandfather	
2.	grandmother	
3.	father	
4.	mother	
5.	son	
6.	daughter	
7.	brother	
8.	sister	
9.	uncle	
10.	aunt	
11.	nephew	
12.	niece	
13.	cousin (male)	
14.	cousin (female)	
15.	brother-in-law	
16.	sister-in-law	
17.	father-in-law	
18.	mother-in-law	
19.	son-in-law	
20.	daughter-in-law	
21.	grandson	
22.	granddaughter	

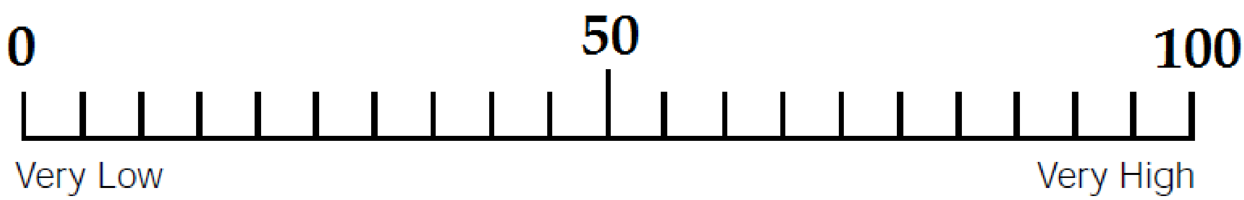
Appendix I

Adapted NASA TLX Cognitive Load Metric

Cognitive Load Metric—Instructional Intervention

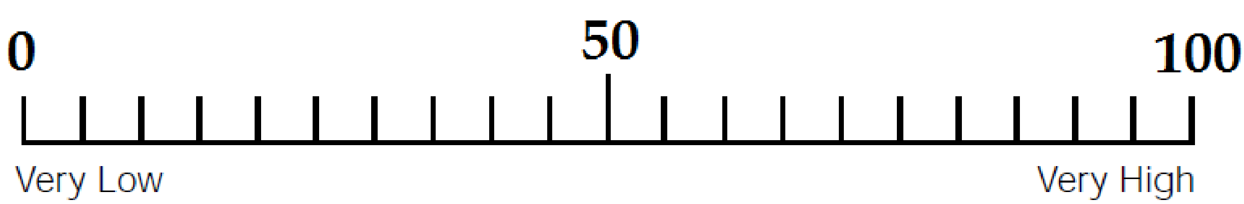
Instructions: Answer each of the five questions with a number, ranging from 0 to 100, on the line provided.

1. How much mental activity (e.g., thinking, deciding, calculating, remembering, looking, searching, etc.) was required to learn this topic from the tutorial you just completed? Rank your answer from 0 (very low mental activity) to 100 (very high mental activity).



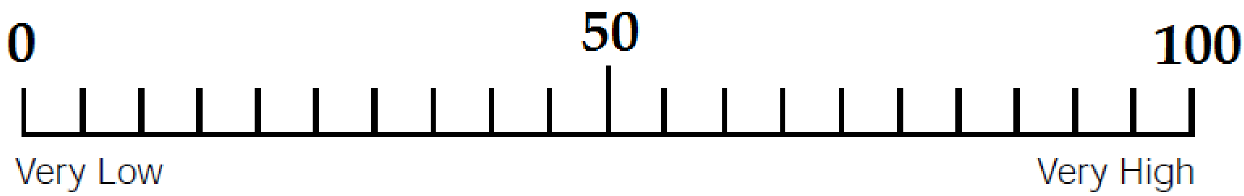
Your score: __________

2. How much mental effort was required (i.e., how hard you had to work) to understand how to use this new Spanish component? Rank your answer from 0 (very low amount of mental effort) to 100 (very high amount of mental effort).



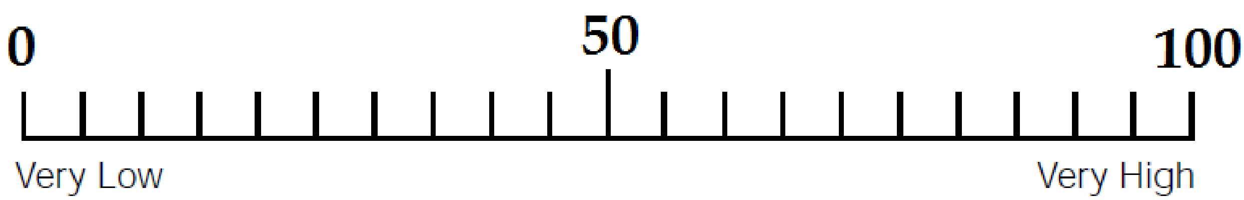
Your score: __________

3. How much effort did you expend in navigating the learning environment (e.g., mousing, searching, clicking, recording, typing)? Rank your answer from 0 (very low amount of effort) to 100 (very high amount of effort).



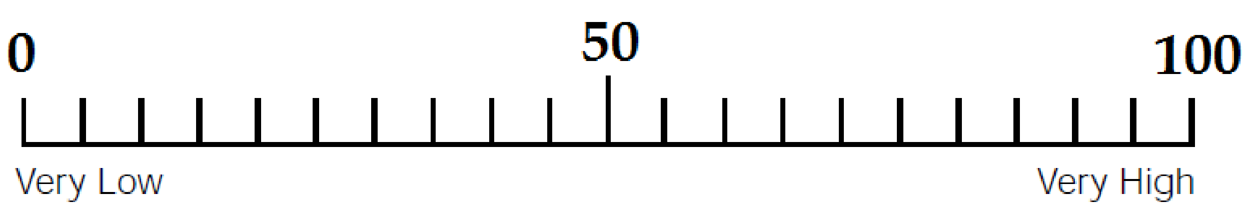
Your score: ________

4. How successful did you feel in learning this new? Rank your answer from 0 (very low amount of success) to 100 (very high amount of success).



Your score: ________

5. How much stress did you feel during the tutorial that presented you with this new Spanish component? Rank your answer from 0 (very low amount of stress) to 100 (very high amount of stress).

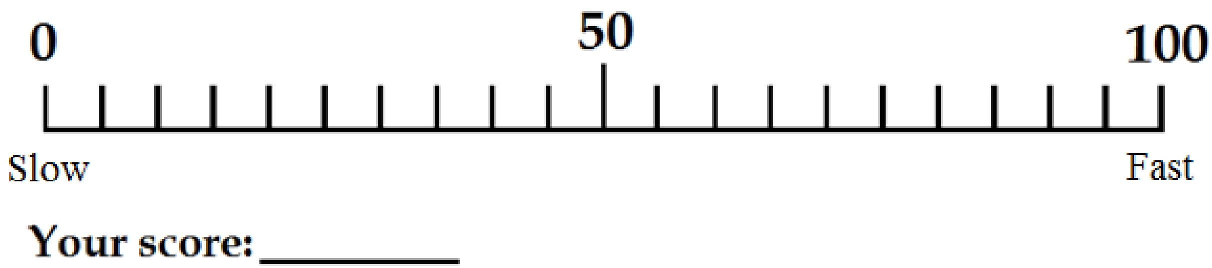


Your score: ________

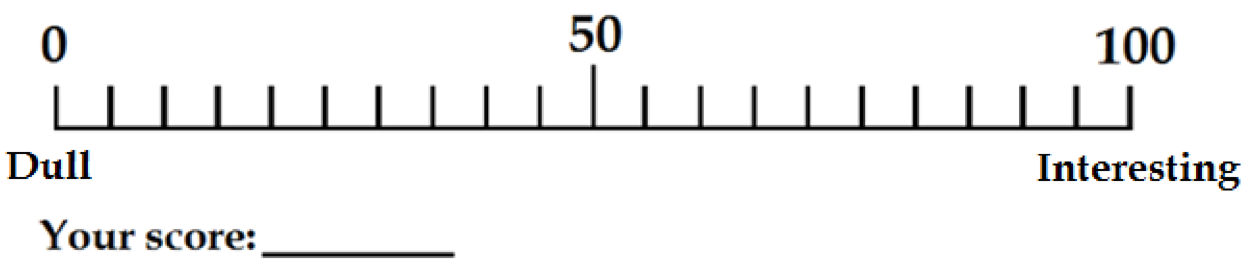
Appendix J

Motivation Survey Adapted from Ross (1983) and Ross & Anand (1987)

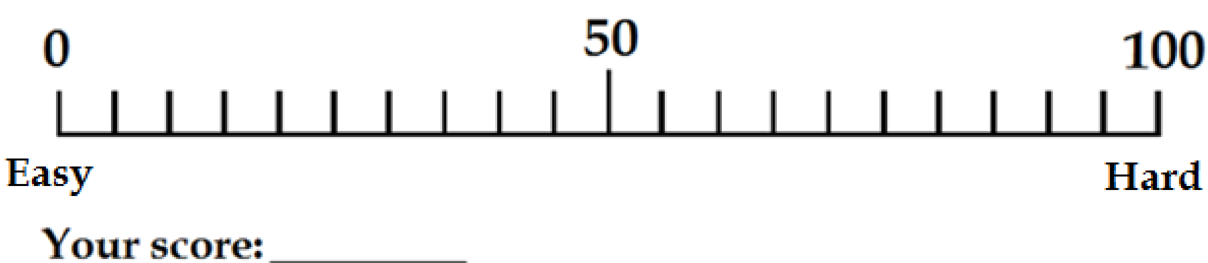
1. Rank the pace of the tutorial from slow 0, to fast 100.



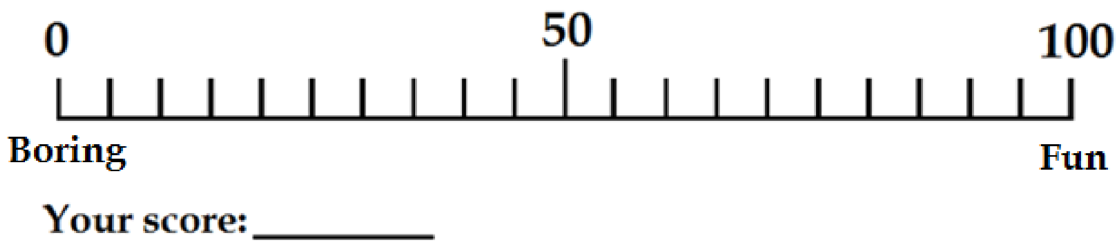
2. Rank the tutorial for interest, from dull 0, to interesting 100.



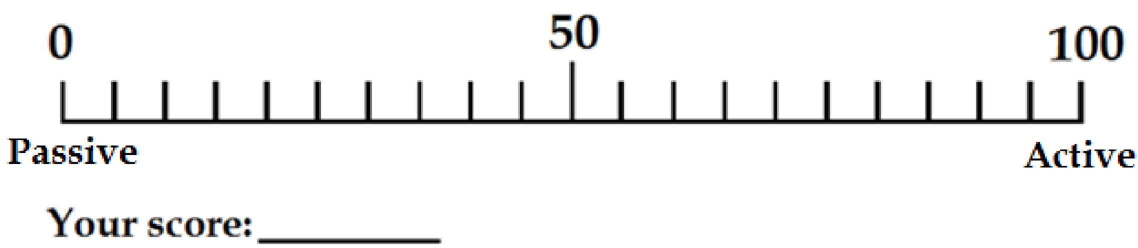
3. Rank the tutorial for difficulty, from easy 0, to hard 100.



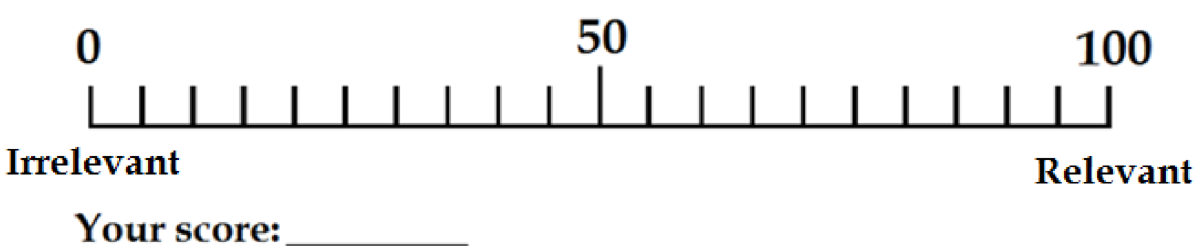
4. Rank the tutorial from boring 0, to fun 100.



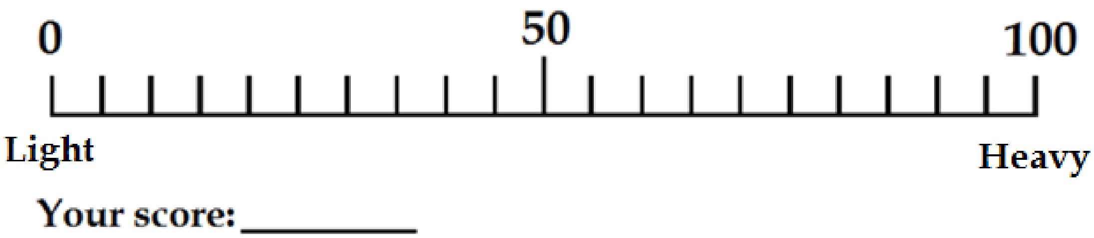
5. Rank the tutorial from 0 passive, to 100 active.



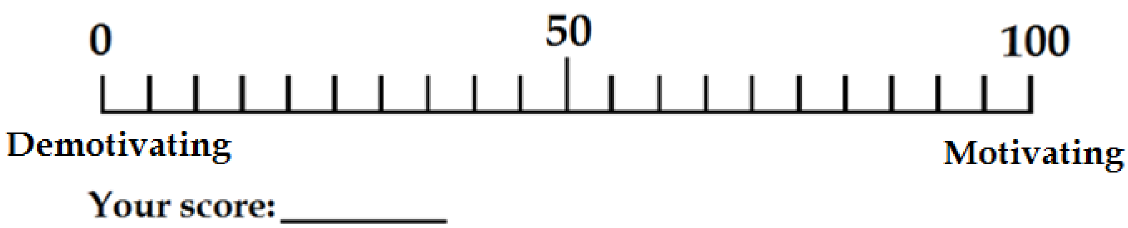
6. Rank the tutorial for relevance, from irrelevant 0 to relevant 100.



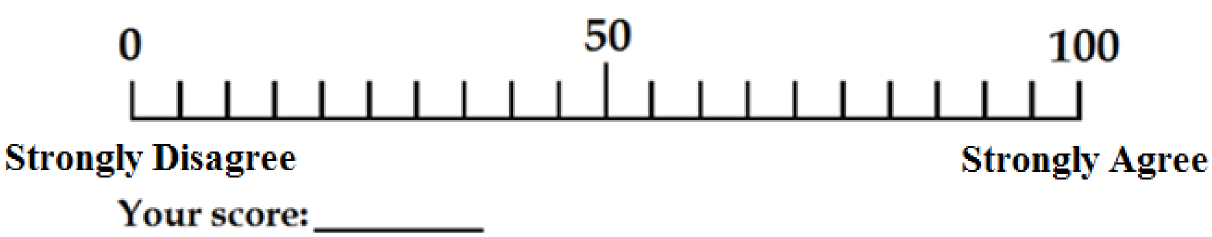
7. Rank the tutorial from 0 light, to 100 heavy.



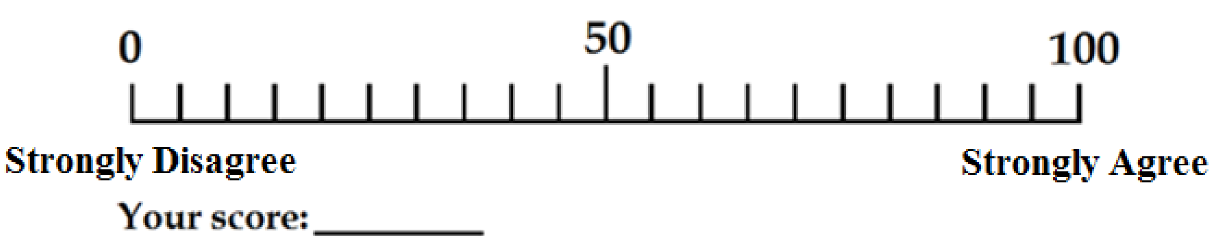
8. Rank the tutorial from 0 demotivating, to 100 motivating.



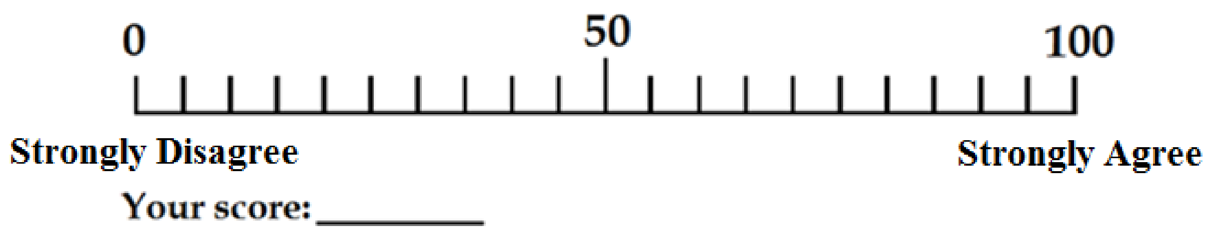
9. Instruction was more understandable than in other units.



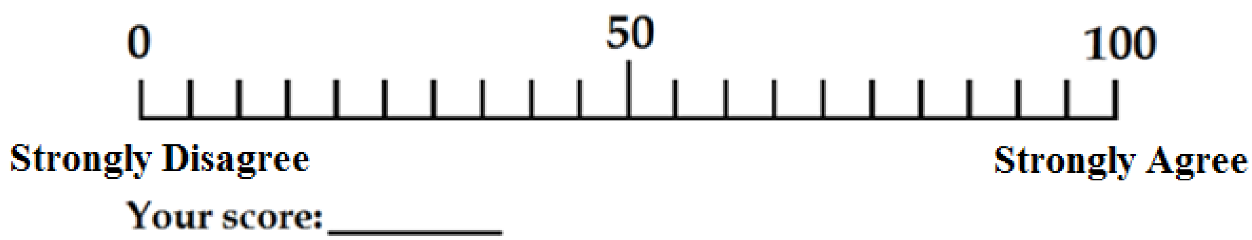
10. Instruction was more enjoyable than other units.



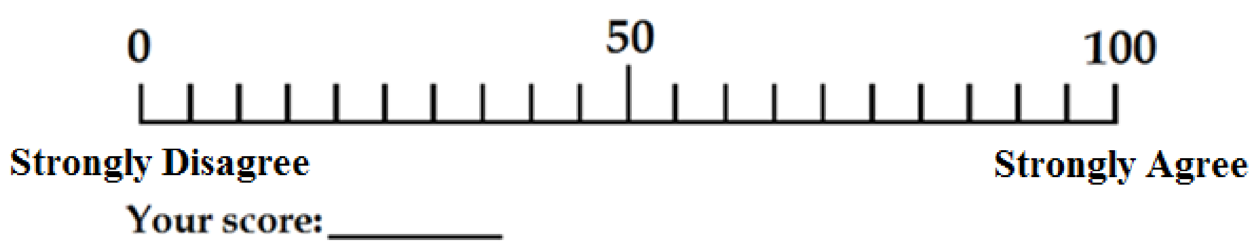
11. Vocabulary terms taught by this instruction were easier to remember than in other units.



12. The instruction put me in the problem situation.



13. The instruction held my attention.



Appendix K

Free-Recall Posttest (Retention Task)

Instructions: In the space provided below, please write as many family-related vocabulary terms in Spanish as you can remember from the tutorial.

Appendix L

Fill-in-the-Blank Posttest (Transfer Task)

Instructions: Start the slideshow and you will hear a phrase with a blank to be filled-in. The blank will be represented by a beeping sound. You will write the word that fits in the blank on your answer sheet. Click the audio icon with your mouse as many times as you need, in order to fill-in the blank provided on your answer sheet. When ready, press the space bar or the right arrow to go on to the next item. Try to complete the exercise as quickly and with as much accuracy as you can.

1.)_______________ [Script: Tú eres la _________ de tu abuela. (You are the __________ of your grandmother.)]

2.) _______________ [Script: Tú hermano es el __________ de tu abuela. (Your brother is the __________ of your grandmother.)]

3.) _______________ [Script: Tu hermano es el __________ de tu padre. (Your brother is the __________ of your father.)]

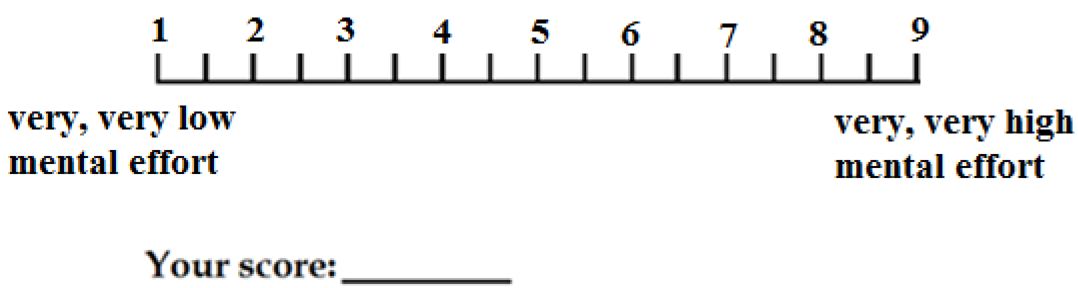
4.) _______________ [Script: Tú eres la ___________ de tu madre. (You are the __________ of your mother.)]

5.) _______________ [Script: Tú eres la __________ de tu hermano. (You are the __________ of your brother.)]

6.) _______________ [Script: Tú eres la __________ de tu tío. (You are the __________ of your uncle.)]

7.) _______________ [Script: Tu hermano es el __________ de tu tío. (Your brother is the __________ of your uncle.)]

Now, please rank items 1-7 for mental effort using the scale below:



8.) ________________ [Script: El padre de tu madre es tu ___________. (The father of your mother is your ___________.)]

9.) ________________ [Script: La madre de tu madre es tu ___________. (The mother of your mother is your ____________.)]

10.) ________________ [Script: El esposo de tu madre es tu __________. (The spouse of your mother is your ___________.)]

11.) ________________ [Script: La esposa de tu padre es tu ___________. (The spouse of your father is your ___________.)]

12.) ________________ [Script: El hijo de tu padre es tu ___________. (The son of your father is your___________.)]

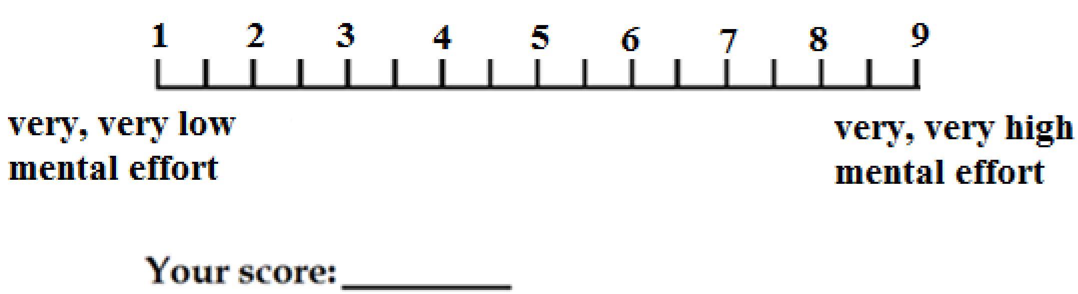
13.) ________________ [Script: El hermano de tu madre es tu ___________. (The brother of your mother is your ___________.)]

14.) ________________ [Script: La hermana de padre es tu ___________. (The sister of your father is your ___________.)]

15.) ________________ [Script: El hijo de tu tío es tu ___________. (The son of your uncle is your ________.)]

16.) ________________ [Script: La hija de tu tío es tu ___________. (The daughter of your uncle is your ___________.)]

Now, please rank items 8-16 for mental effort using the scale below:



17.) ________________ [Script: El hermano de tu madre es el ___________ de tu padre. (The brother of your mother is the ___________ of your father.)]

18.) ________________ [Script: La hermana de tu padre es la ____________ de tu madre. (The sister of your father is the ___________ of your mother.)]

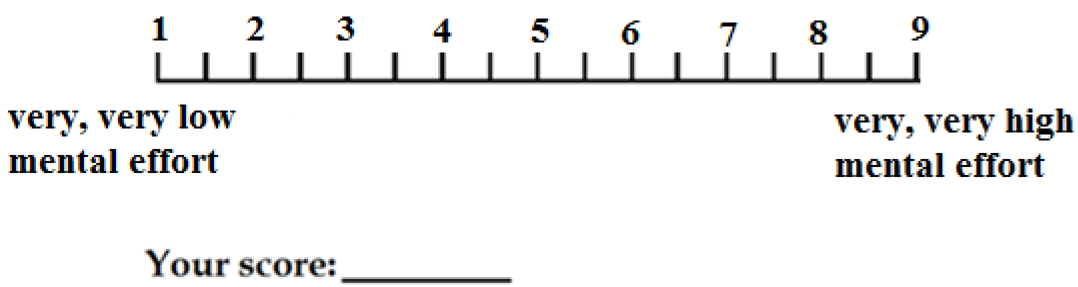
19.) ________________ [Script: El padre de tu padre es el ____________ de tu madre. (The father of your father is the ___________ of your mother.)]

20.) ________________ [Script: La madre de tu padre es la ____________ de tu madre. (The mother of your father is the ___________ of your mother.)]

21.) ________________ [Script: Tu madre es la ___________ de la padre de tu padre. (Your mother is the ___________ of the father of your father.)]

22.) ________________ [Script: Tu padre es el ___________ de la madre de tu madre. (Your father is the ___________ of the mother of your mother.)]

Now, please rank items 17-22 for mental effort using the scale below:

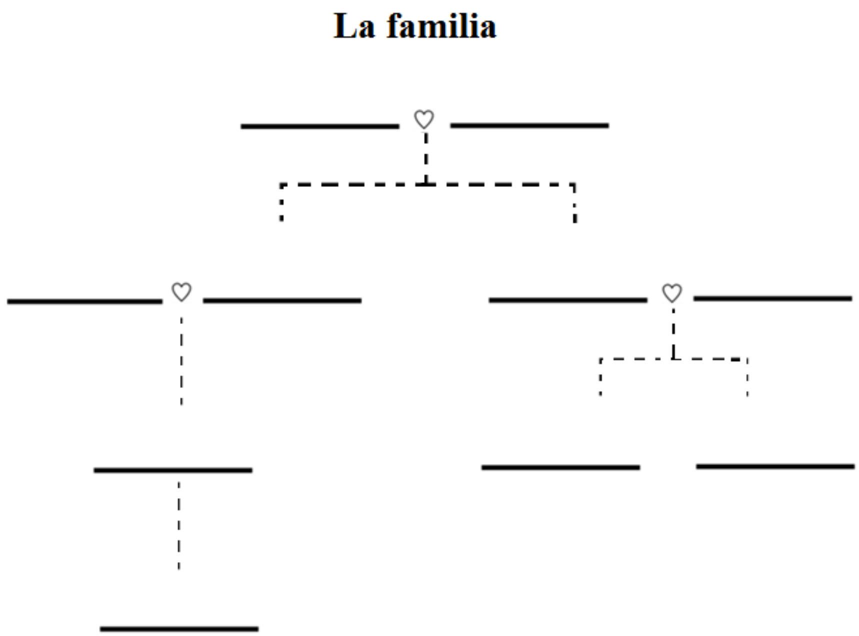


Appendix M

Problem-solving posttest (Transfer Task)

Instructions: Use the clues to complete the pedigree chat for María's family. You will be evaluated based on the speed and accuracy with which you complete the chart.

Pedigree Chart:



Clues:

Jorge	Jorge es el cuñado de Lisa.	**María**	María es la abuela de la familia.
Marcelo	Marcelo es el padre de Andrea.	**Lisa**	Lisa es la hija de María.
Rico	Rico es el yerno de María.	**Luz**	Luz es la hija de Jorge.
Leandro	Leandro es el primo de Luz.	**Andrea**	Andrea y Lisa son hermanas.
Sultán	Sultán es la mascota del nieto.	**Eva**	Eva es la sobrina de Lisa.

VITA

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Old Dominion University, *Ph.D. Candidate Instructional Design and Technology,* August 2017
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PUBLICATIONS

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Kleinman, C. (2014). Medium or message? *Instructional Technology Council Newsletter.*

CONFERENCEE PRESENTATIONS

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Kleinman, C. (2008). Using voice tools in the foreign language classroom. *Southwest Institute for Learning with Technology*. Flagstaff, Arizona.

Kleinman, C. (2008). The retention of Spanish mood by English speaking bilinguals. *NAU OGSE PEAKS Annual Conference*. Flagstaff, Arizona.