Using Design-Based Research to Guide the Development of Online Instructional Materials

Cristina Pardo-Ballester
Julio C. Rodríguez
Iowa State University

The application of design-based research guidelines to the development of materials for language learning affords excellent opportunities to implement a principled approach to produce materials that integrate relevant second language acquisition (SLA) findings. Because of the iterative and participatory nature of design-based research, materials designed from this perspective are likely to result in products which: 1) are sensitive to the mode, context, and content of language instruction; 2) are appropriate to meet the needs of diverse populations of learners; 3) address learners' interest in particular discourse domains (e.g., business, engineering, etc.); and 4) are presented in interfaces that are optimal for language learning. In this paper, we describe how a design-based research approach is being used in the development of instructional materials for hybrid elementary Spanish courses for university students.

DESIGN-BASED RESEARCH (DBR)

Design-based research (DBR) emerged in the early 1990s in response to the need for context-sensitive methodologies for the design and development of pedagogical innovations (Design-Based Research Collective, 2003). Table 1 provides an outline of definitions and core concepts in the evolution of DBR in the literature. The first studies framed within DBR were referred to as “design experiments.” However, partly because the term “experiment” often evoked a wrong association between this paradigm and experimental research design, researchers began to refer to the approach as “design-based research.” In 2003, a group of researchers from different institutions in the United States (University of California, University of Washington, Vanderbilt University, Pennsylvania State University, The Exploratorium and others), and Israel (i.e., Ben Gurion University of the Negev), self-identified as The Design-Based Research Collective, saw promise in a DBR approach to inquiry and collaboratively formulated a set of guidelines that has since been broadly used to inform research of this type. http://www.designbasedresearch.org/ provides information about the group’s members. This seminal work laid out principles of DBR and became the centerpiece of a special issue of Educational Researcher, which focused exclusively on DBR (Design-Based Research Collective, 2003).

The evolution of DBR has been described as a progression from the study of learning, teaching, and assessment as individual stages of the learning process, to a systemic whole that embodies all three (Bell 2004; Brown, 1992; Collins, Joseph, & Bielaczyc, 2004; Joseph, 2004). In other words, DBR attempts to construct a theoretical model by bringing
together research, design, and learning. One way to understand “design experiments” is by drawing an analogy with the design of a motor vehicle. DBR provides a framework for decisions that are analogous to the process of progressive refinement of a Japanese car, whose design is updated frequently after its initial release based on user-focused evaluation. For this progressive refinement to be effective, theoretical issues must be addressed (Collins et al., 2004). Researchers have also described this approach as an iterative cycle composed of multiple steps such as exploration of the design, enactment of interventions, evaluation and analysis of the outcomes, and redesign (Cernusca, 2007; Cobb, 2001; Dede, Nelson, Ketelhut, Clarke, & Bowman, 2004; Design-Based Research Collective, 2003; Hoadley, 2002, 2004; Yutdhana, 2005). These researchers preferred the term “design-based research” to differentiate it from research design or experimental design which could be easily confused with “design research” (Design-Based Research Collective, 2003). Yet there are researchers who use the terms “design research” and “design experiments” interchangeably (e.g., Collins et al., 2004).

According to the Design-Based Research Collective (2003), DBR is characterized by: a) dual goals manifested in the design of learning environments and the formulation of “proto-theories” of learning; b) iteration in the research and design process; c) the requirement to account for authentic settings; and d) the use of methods suitable to document and relate “processes of enactment” to “outcomes of interest” (Design-Based Research Collective, 2003, p. 5). Scholars participating in this community of inquiry probably agree on two foundational principles: that the development of learning environments and theories is inextricably intertwined, and that researchers must employ methods that make possible the connection between processes of enactment and outcomes of interest, so that our understanding of pedagogical innovations can go beyond the dictum of success or failure (Dede et al., 2004), i.e., beyond summative efficacy judgments, which are often based on limited opportunities to account for or fully understand the instantiation of instructional innovations.

In the first years of this century, DBR evolved into an organized research paradigm to guide research that involves the design and development of computer applications for teaching and learning. Today, DBR is used in fields such as education, psychology, learning sciences, learning technologies, and information science. To the best of our knowledge, no studies have been published in the applied linguistics area, except for Yutdhana’s (2005) overview of DBR and its potential for CALL. Yutdhana (2005) describes two research studies carried out in 2002 by Barab et al., and in 2003 by Bannan-Ritland. The first study focused on the development of a networking Web site to support a virtual community for teachers to reflect, share, and inquire about pedagogy. Bannan-Ritland’s (2003) study created a model called “integrative learning design” composed of four phases: exploration, enactment, evaluation of local impact, and evaluation of broader impact (p.173). This framework was tested with a project called Literacy Access Online, which was designed to help a community (such as teachers, parents, children) understand the collaborative reading processes in children.
Table 1. Working definitions and core concepts of Design-based Research in the literature

<table>
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<tr>
<th>Authors</th>
<th>Definition and/or core concept(s)</th>
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<td>Brown, 1992</td>
<td>Design experiments are composed of three complex features: 1) Input (i.e., teacher training, curricular change, testing, technology innovation, etc) is treated as a whole rather than independently; 2) Output (i.e., particular outcome that a given learning design was intended to achieve); and 3) Contribution to a theory of learning through its enactment in practice or dissemination (pp. 142-143).</td>
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<td>D-BR Collective, 2003</td>
<td>Design-based research is defined as “an emerging paradigm for the study of learning in context through the systematic design and study of instructional strategies and tools.” This method was used “to avoid invoking mistaken identification with experimental design, with study of designers, or with trial of teaching methods” (p. 5).</td>
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<td>Joseph, 2004</td>
<td>Joseph quoted Shavelson, Phillips, Towne, and Feuer (2003) to describe design based research: “Such research, based strongly on prior research and theory and carried out in educational setting, seeks to trace the evolution of learning in complex, messy classroom and school, test and build theories of teaching and learning, and produce instructional tools that survive the challenges of everyday practice” (p. 235).</td>
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<td>Hoadley, 2004</td>
<td>Design-based research is… “an attempt to combine the intentional design of learning environments with the empirical exploration of our understanding of those environments and how they interact with individuals” (p. 205).</td>
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<td>Collins, Joseph &amp; Bielaczyc, 2004</td>
<td>“Design experiments were developed as a way to carry out formative research to test and refine educational designs based on theoretical principles derived from prior research. This approach of progressive refinement in design involves putting a first version of a design into the world to see how it works. Then, the design is constantly revised based on experience, until all the bugs are worked out…Design research is not aimed simply at refining practice. It should also address theoretical questions and issues if it is to be effective” (pp. 18-19).</td>
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<tr>
<td>Bell, 2004</td>
<td>“…The design experimentation term is often misapplied to design activities where objects are taken into authentic educational contexts without any coordinated attempt to engage in theoretically framed empirical research on related educational phenomena. In this form, these research activities are design research, but they are not design experimentation or design-based research” (p.245) He identified four theoretical modes of design-based research based on different fields (such as developmental psychology, cognitive science, cultural psychology, and linguistic or cognitive anthropology). He argued that we should not use the same “design experimentation term to describe this pluralism of research efforts” because it “is confusing and fails to surface the internal logic of each mode of work” (p. 249).</td>
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<td>Yutdhana, 2005</td>
<td>“DBR as a perspective for CALL research takes no sides on the relative merits of quantitative versus qualitative methods. Either, or both, quantitative or qualitative techniques are used to accomplish goals in stages of the design process” (p. 176).</td>
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<td>Cernusca, 2007</td>
<td>He follows Cobb (2001), who proposed the “design research cycle” as a process that starts with a “thought experiment” that synthesizes the pertinent theories and models in a series of theoretical conjectures… “These theoretical conjectures generate the learning trajectory that describes potential means and tools to support meaningful learning. A research trajectory monitors the enactment of the learning trajectory providing feedback on both design and learning factors specific for the given learning context” (p. 15).</td>
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We understand Design-based Research as a paradigm that allows the incorporation of relevant theories to materials development, such as SLA theory and principles of software design and development, such as usability testing. Additionally, by understanding and applying the knowledge of a theory to a design project, new issues emerge with the possibility of developing new theories of learning (Design-Based Research Collective, 2003).

In this article, we describe how DBR can contribute to the development of instructional CALL materials. We focus on the first few milestones in the processes of design, development, and evaluation of reading materials for elementary Spanish in two discourse domains, which we very broadly describe as business and engineering. The processes we describe start with the selection of the authentic domain-specific texts, their elaboration for use in an L2 learning context, and the scaffolds built around these texts for use in class (e.g., glosses, schema activation activities, etc.). We also describe the few initial steps in the evolution of the user interfaces created for these materials.

**DESIGNING THE LEARNER EXPERIENCE**

CALL researchers have long argued for approaches to the development and evaluation of CALL materials that are informed by relevant theories and contexts (Chapelle, 1998, 2001). One way to achieve some synergy between theory and instructional contexts is through the formulation of criteria for the development of instructional materials; for example, Chapelle (1998) proposes that criteria grounded in SLA theory should inform multimedia CALL design. DBR offers the processes to enact such criteria and crystallize them for use in materials development.

Because DBR approaches the design of language learning materials from a holistic perspective, it is well positioned to enhance the synergy between theory and the development of instructional materials in CALL. Through a DBR approach, it is possible to consider both the features which the learning activities themselves should contain for the learner to achieve specific goals (i.e., features we consider at the planning stage) and also particular features that may emerge during the instantiation of language learning activities (e.g., Doughty & Long, 2003), such as the unplanned occurrence of interactions that create opportunities to provide negative feedback. Both of these, activity features and contextual factors, need to be taken into consideration during the development of instructional materials if the goals of the materials is to maximize the learning potential of any given learning experience.

The holistic approach embraced by DRB allows materials designers to work on language learning materials from multiple perspectives simultaneously. The focus of the design process is not only on the construction of materials intended to achieve specific language learning outcomes, but also on the creation of contexts that will support the achievement.
of such outcomes; as a consequence, the instructor’s perspective is also taken into account in the design. The creation of such contexts and the language learning activities embedded in them is what we refer to in this paper as the design of the learner’s experience.

Many contextual factors, such as the interface design contribute to the learner’s experience. Because of its iterative nature, DBR makes it possible to identify, account for, and evaluate many of these factors early during the development of language learning materials, the result possibly being rich and memorable learning experiences for learners when they work with the materials. Figure 1 illustrates the processes involved in the design and development of materials for an intermediate level Spanish language class. As the figure shows, research, design, and development are inextricably intertwined in DBR. The following paragraphs provide more detail on the nuances of the process.

![Design & Development Evaluation](image)

**Figure 1. Designing the learner experience: A graphical representation of DBR processes**

The spiral in Figure 1 represents the multiple design, development (left side), and evaluation (right side) processes that occurred during the development of the instructional materials. The processes listed on the left should be considered as a group, since they are not intended to be in sequential order because they oftentimes overlapped. The right side of the graphic lists instances of formative evaluations of the materials. These evaluation processes were guided by basic tenets of the instructional design approach known as Rapid Prototyping, which encompasses the notions that a) early evaluation is necessary to produce quality instructional products; b) one evaluation is not sufficient to identify real or potential flaws in instructional materials; and c) user participation is necessary throughout the process (Tripp & Bichelmeyer, 1990). CALL researchers have argued that Rapid Prototyping places undue emphasis on the identification of user requirements and may thus not fully address important aspects of interface design such as the importance of
the target knowledge domain (Plass, 1998). However, as an embedded process in DBR, the core concepts of Rapid Prototyping constitute helpful guidelines.

The increase in the dimensions of the upward loops makes reference to the cumulative nature of the DBR process. In every pilot evaluation, knowledge is gained about the materials, which is used to shape subsequent evaluations. For example, the first pilot evaluation in our DBR project helped identify interface features that needed revision, such as the pronunciation icon within the gloss interface, which did not appear to effectively communicate the concept it was intended to represent. After the gloss was redesigned, a second pilot evaluation was constructed with input from the first one in order to corroborate whether the redesign had improved this aspect of the interface. The scope of the second evaluation was also expanded to include features of the main interface for navigation within the course. Similarly, the scope of the third pilot evaluation was extended to include a larger number of reading materials as well as prediction, schema-activation, and reading comprehension activities associated with the readings. The section which follows provides further details on the design of the learner’s experience: it starts by describing some of the characteristics of the course for which the materials are being developed, and goes on to describe the interaction between theory and development in more depth.

**Spanish Hybrid Courses**

We have used DBR to develop two hybrid courses in elementary Spanish that will be used as an alternative to the courses delivered in the traditional face-to-face format¹. These courses constitute the first hybrid foreign language initiative at Iowa State University (ISU). They combine online and face-to-face modes of instruction aiming to take advantage of the best of each modality: traditional face-to-face instruction, online interaction with the instructor, and individualized multimedia instruction on the web.

Due to the flexibility of the online mode, these courses help address language learners’ specific interests by expanding their choices of content relative to the syllabus used in the classroom. In the Spanish hybrid courses, students choose between readings in two broad discourse domains (see Figure 2), namely engineering and business. The selection of these two domains was made because the Department of World Languages and Cultures offers a major option that combines the study of a language (a major or minor in French, German, Russian, or Spanish; or a minor in Chinese) with a major in business or engineering. This dual major option is called *Languages and Cultures for the Professions* (LCP) and has become an increasingly popular choice among ISU students.

During the course, all students work on the readings included in a textbook, which we broadly categorize as “humanities,” and they are asked to choose between two supplemental tracks of business or engineering for their work on the Web. Readings that focus on these two domains are particularly attractive to students in business and
engineering, especially those who are considering pursuing an LCP major or minor. To keep the thematic integrity of each chapter as a unifying aspect of the course, we created thematic alignment between the topics in the textbook and those we selected for supplemental reading. For example, a topic from the textbook is about culture, for example giving information about Costa Rica. In the reading when referring to Costa Rica one of the themes mentioned is the forested lands. From this theme we take the theme “wood” and located a reading about the properties of the wood and the different tools used with this product (e.g., reading for engineering). Another theme from the Costa Rica’s reading is the tourism and a way to educate tourists how to protect the environment. From this theme, we find a reading about the responsibilities of a company related to a topic such as environment.

Figure 2. Three discourse domain areas for the online readings as depicted in the interface

The linguistic content in the courses offered in the hybrid format is equivalent to the content in the first two semesters of an introductory college-level Spanish curriculum. These courses contain the same elementary Spanish grammar points (e.g., *ser* vs. *estar*, present, past, and future tenses, etc.) which are taught in the regular Spanish curriculum, but they differ in the mode of instruction. While traditional courses often have four weekly face-to-face sessions, our hybrid versions have two weekly face-to-face meetings and the rest of the work is done through the online medium. When not attending a face-to-face session, students in the hybrid courses alternate between synchronous online meetings, the use of task-based multimedia Web materials made available through a course management system (WebCT), and proctored online assessments made available via a distance learning testing facility. During the synchronous online sessions (which are carried out in the Adobe Connect conference system) students are grouped by the instructor and required to complete communication tasks using both text and voice chat with their instructor and peers.

All of the technologies mentioned above contribute to creating rich environments for blended learning. However, instructional materials for a traditional face-to-face mode and those for a purely online mode assume different types of instructional contexts. In view of the apparent limited options in instructional materials for hybrid modes of instruction in our specific instructional context, we embarked on the task of creating our own.
The following section focuses on two specific milestones in the development of these materials, namely, a) the creation of guidelines for construction of multimedia glosses; and b) the formulation of criteria for the selection of textual elements to be glossed in the supplemental readings. These milestones illustrate some of the characteristics of DBR, namely the flexibility of DBR to operationalize combinations of relevant theoretical constructs by incorporating them into core aspects of the design of the learner’s experience, the emergence of new issues prompted by attempts to operationalize theory, and the presence of iteration in the process of creating the materials.

**Criteria for Developing CALL Reading Materials**

A DBR approach to materials development needs to incorporate theoretical perspectives about how learning occurs in the particular domain of study. In second language acquisition, Chapelle (1998) identifies some implications of interactionist SLA for the design of multimedia CALL, which we drew upon in developing criteria for the reading materials. Specifically, we based the development of the multimedia glosses and the reading materials on three SLA hypotheses grounded in theory and research, namely the notions that a) salient input may promote SLA processes, b) assistance comprehending linguistic input, creates opportunities for acquisition; and c) opportunities to produce the target language are good for acquisition. The following paragraphs explain how these hypotheses were incorporated into the design of the instructional materials.

**a) Target input needs to be made salient.** Theory and some research suggests that SLA processes are enhanced when learners notice the linguistic input targeted for acquisition, for example, when a particular morphological form is made salient through some sort of textual enhancement, such as through the use of boldface font, a change in font color, and so forth (Chapelle, 1998; Gass, 1997; Hegelheimer & Chapelle, 2000). Extending this idea to CALL materials, we identified ways to offer students salient linguistic input to help them notice important features. While working with the online readings, learners have control of the extent to which input is made salient. When learners open the text, the targeted linguistic forms (i.e., high-frequency items such as lexicon, prepositions and expressions) are made salient using a subtle change in color (maroon) by default. However, learners may choose to display the text in two alternative modes: 1) with high-contrast highlights (a gold background highlights the linguistic form); or 2) with no highlight. When using the latter mode, learners can still identify glossed terms by the change in the mouse pointer from the arrow to the hand icon that signals an active link when the pointer hovers over the glossed term. Additionally, learners are given the opportunity to notice and investigate more deeply the unknown input by using various study aids such as, multimedia glosses containing pictures, videos, pronunciation, synonyms, and translations into English.

**b) Learners need help comprehending linguistic input.** SLA researchers have argued that authentic input (particularly if it is written by and for native speakers) is too
difficult for learners (Doughty & Long, 2003; Long, 2007), especially for low-proficiency learners. They suggest that target language (TL) input should be modified for learners to be able to understand and better process the unknown forms. One popular way to adapt materials prepared for native speakers has been to simplify the texts. This has been done by limiting linguistic forms syntactically, semantically, and morphologically, at the expense of losing stylistic and/or discourse domain-specific features that are an essential part of the text. Long (2007) indicates that this type of simplification actually impedes learning because important linguistic features are removed from the text and learners are being exposed to unnatural language use. Input elaboration (Doughty & Long, 2003; Long, 2007) has been proposed as an alternative approach to improve the comprehensibility of TL texts. The background for this approach comes from research on “foreigner talk discourse” and there is extensive research showing that elaborated input can facilitate reading comprehension (see Long, 2007 for a review of this research).

In line with Long’s (2007) synthesis of research on elaborated input, we selected authentic texts and then retooled their presentation to low-proficiency learners by increasing redundancy, regularity, and explicitness while preserving the original TL linguistic structure of the text. We did this by:

- Introducing thematic alignment with other readings. For each reading in the textbook, two additional readings were added. The additional readings focus on topics related to business or engineering. The topical content of the additional readings was thematically aligned with the content in the textbook reading. For example, the textbook reading on “Fiestas in the Hispanic Countries” was supplemented with a technical text on light because this theme is mentioned in the humanities reading when talking about decoration as an important aspect in the Hispanic fiestas, and with a business text on economic aspects of Halloween. All three texts then follow a common thematic thread on festivities, and therefore build from a common schema and lexical expressions, but focus on social, technical, and economic aspects of the topic.
- Replacing low-frequency lexical items with higher frequency synonyms. A frequency dictionary created with authentic spoken and written corpora guided this process (Davies, 2006)
- Replacing pronouns with full NPs
- Keeping subject pronouns (in Spanish, they are often dropped)
- Matching the order in which events are mentioned with the order in which events take place. For example, using “a slowdown of the economy made businesses close” instead of “businesses were closed after a slowdown in the economy.”
- Using cognates when possible and eliminating false cognates
- Using high frequency connectors (e.g., pero [but], así [in this way], etc.)

c) Providing opportunities to produce target language output. After reading the texts, learners have the opportunity to produce written and spoken output using the target input in the readings by engaging in a task named Un paso más (One step further), which
supplements each reading. Students write and talk to the instructor using a learning management system (WebCT Vista). The readings and supplemental tasks are presented in the sequence in the learning management system. The instructor can give feedback to students through audio messages (Wimba Voice Tools) or written messages.

Figure 3. Reading tasks sequence: a) before you read (antes de leer); b) Reading Chapter 1 (Lectura Capítulo 1); c) after you read (después de leer); d) one step further (un paso más)

A Multimedia Gloss

We define a gloss as an instructional aid used to promote learner independence by supporting learning during the interaction with a text. Roby (1999) elaborates the complexity of this definition by pointing out that researchers have used different terms to refer to glosses, such as paratext, metanotes, or adjunct aids to mention a few. Even if glosses have been historically related to lexical information (Lomicka, 1998), Roby (1999) recalls the study of a lexicographer (Hüllen, 1989), who related glosses not only to vocabulary (for example, by using synonyms) but also to encyclopedic comments and grammatical notes. In his detailed account of gloss types and functions, Roby provides a valuable taxonomy of glosses (1999), which formed the basis for development of our glosses. We provided glosses to learners in the online readings to help them 1) focus on the form and vocabulary; 2) increase their motivation to read in Spanish; 3) interact with the text; 4) better learn and retain linguistic input.

Following Roby’s (1999) taxonomy the glosses used in our readings fall into the category of professional glosses, that is, glosses written by teachers and materials developers. The function of our glosses was specifically declarative. In other words, learners have access to 1) factual knowledge, such as the definition of a certain word from an encyclopedia, or 2) linguistic explanation which supports learning lexical and syntactical features. The languages used in the glosses are Spanish (synonyms) and English (translations). Grace (1998) suggests that the combination of L1 and L2 help might be ideal for aiding beginners with vocabulary retention. Vocabulary acquisition may be facilitated by accommodating different types of users through the use of different options, such as language selection.
Another important feature of our multimedia glosses is that the linguistic input presented in every gloss is given in a variety of forms (see the left-side menu options in either prototype depicted in Figure 4). Research has shown that associating a word with an image may help learning or recalling the meaning more easily than a text definition alone (Chun & Plass, 1996; Yoshii, 2006). Researchers in the field of SLA have concluded that presenting a gloss in a variety of modes, such as textual, visual, auditory, and so forth, serve different functions in facilitating vocabulary acquisition and retention (Al-Selhayer, 2001; Chun & Plass, 1996; Lomicka, 1998). Therefore, we decided to include a variety of media types: a still picture; the pronunciation of the glossed item(s); a synonym, if possible, or otherwise a simplified definition or explanation in Spanish; a short video; and finally a translation or explanation of the item(s) in English.

![Figure 4. Multimedia gloss interface prototypes](image)

A variety of prototypes of the gloss interface were tested in a Rapid Prototyping process during the development of the glosses. Figure 4 shows one of the three versions of the first prototype. Following a principled approach to interface design, we distinguished between sovereign and transient application interfaces: (Cooper, Reinmann & Cronin, 2007). In our project, the former constituted the main interfaces for the materials, such as the learning management system interface and the interface developed for the reading materials. The latter consisted of an embedded multimedia gloss interface intended to scaffold the reading tasks. Unlike the main interface, the transient interface is invisible by default and its activation depends on how the learners interact with the text.

Several versions of the first transient interface prototype were included in the initial usability test. We placed the embedded gloss menu in three different positions, namely on the left, right, or top of the window. Learners who participated in the first usability test favored placement of the menu on the left. Other changes between the first and second prototype are shown in Figure 4. The revised prototype (Prototype 2) addressed the
problems identified during the first pilot, including 1) ambiguity in gloss reference (note that Prototype 2 displays the glossed item in the title bar of the window, making it clear which term in the text is being glossed); 2) icon order (the translation icon was placed below the video icon) and iconic reference (the locations of the picture and pronunciation icons were interchanged); and 3) undefined visual space (borders were added to make a clear visual separation between the embedded transient interface and the text in the reading).

Criteria for Glossing and Problems Following Criteria to Gloss

The construction of the gloss and the selection of linguistic forms targeted for glossing are related, albeit different, processes. As explained above, all learners work with the textbook readings as part of the course assignments. Since the textbook readings gloss particular items, we began by identifying and glossing in all the elaborated readings all the lexical items that were also glossed in the textbook readings. In order to do this, we created a list of the vocabulary items glossed in the textbook.

Using this list, we identified occurrences of the same lexical item in all the elaborated texts (i.e., engineering and business) and then occurrences of their linguistic variations (e.g., different gender, number, conjugation, etc.). Whenever a semantic equivalence appeared between a lexical item glossed in the textbook and one used in the elaborated readings, we replaced the item in the elaborated reading with the one in the textbook. The main purpose of this process was to ensure a common core of lexical items that could be targeted for assessment.

The next step was to identify domain-specific lexical items in the elaborated texts that would be targeted for glosses. In order to identify such items, we used the following criteria: a) the lexical item needed to be semantically related to the main topic of the text; b) the item had to be necessary in order to understand the main ideas in the text; c) higher frequency items were chosen over lower frequency ones, as long as meaning was not significantly altered from the original item included in the authentic text. Davies’ frequency dictionary for Spanish (Davies, 2006) was used to select high-frequency lexical items. Researchers in second language vocabulary acquisition indicate that 5,000 base words is the minimum requirement for understanding non-specialized texts (Laufer, 1997); the minimum base words needed to understand technical texts averages 7,000 words (Groot, 2000). Taking into consideration the proficiency level for which the materials are targeted as well as the domain-specific nature of the texts, we established 2,500 as the threshold to select high-frequency items.

Although we originally decided to avoid using items that ranked higher than 2,500, this criterion was not always possible to implement so exceptions needed to be made. Texts in specific discourse domains presented us with a paradox: the more a text conforms to a specific discourse domain, the higher the occurrence of low-frequency lexical items. For example, in one of the elaborated texts for engineering, one encountered the word *grieta*
(crack), which we expected to have a high-frequency rank (i.e., under 2500). However, Davies’ (2006) frequency dictionary ranks this item at 4,788. Following our criteria, we then looked for a semantically equivalent lexical item with a higher frequency. The closest option was the term agujero (hole), which, again, had a frequency rank of 3,128, which exceeded our threshold. We decided to use the word hueco (similar to hole in Spanish, depending on the context, but literally “hollow,” as a noun) at a frequency rank of 2,880. Arguably, the word hueco still communicates the concept in Spanish.

As the description above shows, an additional challenge we faced when applying these criteria was overcoming native-speaker perceptions as to which lexical items would occur with high frequency. As two L1 Spanish speakers, we were surprised to find that our assumptions concerning word frequency were often wrong, so the use of a frequency dictionary was a valuable tool to counteract our bias.

CONCLUSION

This paper constitutes a first attempt toward unveiling the potential of DBR to inform and possibly improve the development of instructional materials for language learning. In particular, we focused on the theory and research from SLA and CALL that inform three aspects of the design. This project drew upon this prior work, but also tested in operationalization through the DBR processes of iteration, participation, connection of design processes and outcomes of interest, sensitivity to context, and dual foci of designing learning experiences and developing theories of learning (Design-Based Research Collective, 2003). Overall, DBR affords a framework for applied research that is deeply embedded in the content and context of language instruction, as well as instructional materials that may better help achieve quality CALL environments and positive experiences for learners with CALL because of the following:

1) Sensitivity to the mode, context, and content of language instruction. The requirement to include authentic settings in the evaluation of materials ensures that not only predictions based on the design, but also important aspects of the context of use of those materials are accounted for and included in early stages of development.

2) Attention to needs of diverse learners. Multiple interaction choices in materials provides learners a chance of finding materials interesting and engaging, but it also presents the risk of overwhelming the learner with information or choices. The iterative nature of DBR helps developers not only assess how particular aspects of the materials work in the target context of use, but also helps them improve features to which students react positively and drop those which do not appear to add value to the learning experience. If developers have many opportunities to monitor aspects of the learners’ interaction with the materials, such as engagement, cognitive load, interface use, and so forth they have the option of making informed and principled decisions supported by theory and data.
3) Consideration of learners' interest in particular discourse domains. Commercially-available materials tend to cast the widest possible net to attract the biggest possible pool of adopters. This makes economic sense but it sorely limits options for learners who are often given no choice of topical content, especially in lower-proficiency language courses (e.g., beginning and intermediate). Having research-supported “blueprints” to create domain-specific materials probably makes more sense from a pedagogic than an economic perspective. DBR processes may help developers gain valuable insights into language learners in specific contexts which may in turn inform the production of future commercially available materials.

4) Interfaces which are optimized for language learning. A DBR approach to designing interfaces for instruction and learning offers not only the possibility of detecting and addressing serious interface problems, but also of adding or dropping features based on research findings at very early stages of piloting. The processes of applying hypotheses and findings about SLA described in this paper can profit from the application of DBR guidelines. Linking those processes to a holistic and contextualized research approach such as DBR helps establish a principled approach to the development of materials which is grounded in relevant theories and findings. DBR thus marks the beginning of a promising interaction between research in applied linguistics and the development of instructional materials for second and foreign language learning.

ENDNOTES

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