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# *Developing Spanish Online Readings Using Design-Based Research*

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The more we know what multimedia is needed for language teaching and the more we understand how to deliver it, the less likely it seems that we can actually ever develop what we imagine. (Pusack, 1999, p. 40)

## **ABSTRACT**

This article reports on the use of design-based research (DBR) in the development of online reading materials for beginning and intermediate Spanish learners. The report focuses on four studies of two main aspects of the development, namely, interface design and learner perceptions. The discussion of interface design includes the analysis of learner expectations and interface organization. The analysis of learner perceptions includes frequency of use and impact of multimedia glosses on the learning of vocabulary. Findings reveal the importance of involving learners in all aspects of materials design and development and make evident the strengths of a DBR approach to the research and development of instructional materials for language learning.

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## **KEYWORDS**

Design-based Research, Interface Design, Multimedia Glosses, Reading

## **INTRODUCTION**

This project arose from the need to provide beginning and intermediate Spanish language learners with effective online reading materials that represent discourse domains relevant to the context of our university, namely, business and engineering. These online reading materials, which were created to supplement the textbook readings, are thematically aligned with the topic of each textbook reading, which we categorize as the humanities readings. For example, one of the readings from the textbook is about fiestas in Spanish-speaking countries, and one of the topics of this reading is holiday decorations. Vocabulary related to holidays such as 'streetlights,' 'paper lanterns,' and 'lamps' is used throughout the text. To align the business and engineering texts thematically, we chose texts related to light and the economy of holidays, respectively. The engineering text we chose focuses on how light works, the business text on the economic impact of Halloween.

Once the specialized readings were selected, they were elaborated following the strategies presented in Long (2007), which include increasing redundancy, regularity, and explicit-

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ness. According to Long, elaborated input improves the comprehensibility of authentic texts. The specialized readings were lexically aligned with the humanities texts in the textbook in three ways by (a) identifying and glossing the same lexical items that were already glossed in the text's humanities reading, (b) replacing lexical items in the specialized readings by items that already appeared in the humanities readings and that had similar semantic value, and (c) replacing low-frequency lexical items with high-frequency ones. A frequency dictionary for Spanish (Davies, 2006) was used to identify and gloss lexical items. A more detailed account is found in Pardo-Ballester & Rodríguez (2009).

We developed multimedia glosses (see Figure 1 below) for all readings. These have been hypothesized to help learners integrate linguistic information into long-term memory (Roby, 1999). The development of the online readings was guided by relevant theory, for example, (a) salient input may facilitate SLA processes, (b) support for understanding linguistic input (e.g., elaborating semantic input) creates opportunities for acquisition, and (c) opportunities to produce the target language are beneficial for acquisition (Chapelle, 1998).

## **INTERFACE DESIGN BACKGROUND**

This section provides a brief overview of the main theoretical concepts of interface design on which this project is based as well as descriptions of the most important elements of the project's several interfaces. Drawing on the literature of interface design, we identified two categories of interface: sovereign interface and a transient interface (Cooper, Reinmann, & Cronin, 2007). The sovereign interface is typically kept open during work on a task, while transient interfaces are typically activated only temporarily to work on a specific task or check on the status of a specific process. For example, in a word processor the sovereign interface is typically the text entry window kept open while text is being created, while the page setup dialog box would be a transient interface and be open for specific purposes.

For this project, we developed four types of interfaces: (a) the sovereign interface of the learning management system (LMS; in our case, WebCT), (b) a sovereign course interface embedded in the LMS (the course homepage), (c) a sovereign interface developed to present the class readings, and (d) a transient interface developed to present the content of the glosses. Each interface presented challenges in ease of use for both learners and designers and degree of impact in the course and materials.

The LMS course interface does not allow for much manipulation. It consists of a menu which can be shown vertically or horizontally. Even though menu items can be shown or hidden, the main "Content" item in the menu is always visible and gives access to the main course interface, which in turn gives access to materials presented in the readings or glosses interfaces. The development and evaluation of the last three types of interfaces entailed a similar design cycle: construction of a prototype, evaluation of the prototype, and a revision of the prototypes based on the feedback collected in evaluation. The following section provides more details on the design process of each of the three interfaces.

## **THE STUDY**

The present study encompasses four consecutive pilot studies: Study 1, 2, 3, and 4. The goal of the four studies was to investigate two specific aspects of the development of the instructional materials: interface design and learner perceptions. Given the fact that learners cannot manipulate preferences in either the sovereign and transient interfaces, it is important

to know how well the interfaces match learners' expectations regarding both placement and function of interface elements. Our specific research questions were

1. How well do learners' expectations regarding the location and function of interface elements match the reality of the actual interface? and
2. How do learners perceive the instructional materials designed to assist them in their language learning?

This study incorporates the theoretical guidelines of design-based research (DBR), a paradigm that evolved in the early 1990s. DBR emphasizes the need for highly contextualized research and is characterized by (a) iterative cycles in the research process, (b) the use of authentic contexts for data collection and the operationalization of theoretical constructs, and (c) the use of methods that enable the researcher to draw meaningful connections between the "processes of enactment" and "outcomes of interest" (Design-Based Research Collective, 2003, p. 5; for a more detailed discussion of the potential of DBR in Applied Linguistics and CALL, see Yutdhana, 2005; Pardo-Ballester & Rodríguez, 2009.) DBR offers a research framework that natively embodies (a) the use of a suite of tools to capture and build detailed accounts of the students' learning experience, (b) consideration of both quantitative and qualitative measures, (c) the use of a variety of data collection methods to produce rich descriptions of the phenomena being researched, and (d) the inclusion of relevant theoretical and conceptual work (Levy & Stockwell, 2006).

## **METHOD**

### ***Participants***

The four studies, combined, included 119 students enrolled in beginning and intermediate Spanish courses at Iowa State University. Below is a detailed description of the participants in each study.

### **Study 1**

Study 1 was conducted in May 2008 and included 6 female students enrolled in the second semester of first-year Spanish. The learners tested one reading text in humanities and one text in engineering over a 3-day period during their free time.

### **Study 2**

Study 2 was conducted in August 2008 in a single day with a total of 13 students (9 females and 4 males) enrolled in second-year Spanish. Eleven learners were native speakers of English, and the remaining 2 were native speakers of, respectively, Chinese and Russian.

### **Study 3**

Study 3 was conducted over a month and a half in September-October 2008 and included 34 students enrolled in the first semester of first-year Spanish (13 participants were female and 8 were male; the rest of the participants did not answer this question). Two participants were native speakers of Chinese, 1 of Vietnamese, and 1 of Hindi.

## **Study 4**

Study 4 took place in April 2009 and involved 65 students enrolled in the second semester of first-year Spanish (33 females and 31 males, 1 participant did not answer). Sixty-one participants selected English as their native language, 1 participant selected Russian, 2 Chinese, and 1 Arabic.

## **Materials**

### **Questionnaires**

All four studies requested learners to provide demographic data, usability data, and their opinions about how various course and multimedia gloss components assisted in their language learning. Each questionnaire included a set of core questions that remained constant over all four studies and a set of new questions that arose out of the need to clarify or expand information obtained in a previous study.

### **Screen captures**

During Study 1, learner interactions with the texts and glosses were recorded using Camtasia.

### **Online texts and multimedia glosses**

Learners individually read each online text and used the multimedia glosses freely. In each chapter (six chapters per semester) learners worked with two readings. First they worked with the readings included in the textbook, which we categorized as “humanities,” and then chose between the business or engineering readings. The students worked at home and could access the online readings and use the multimedia glosses as many times as they wished before taking a postreading assessment. Glossed terms in the readings were highlighted in maroon. To look up a word, learners clicked on the word to display a multimedia gloss in a pop-up window. While the gloss was open, learners could choose between five options represented by icons, namely, picture, synonym, pronunciation, video, and translation. The picture depicting the concept was the default option for all glosses.

## **Procedure**

### **Study 1**

Participants were contacted via email and asked to participate on a voluntary basis in a study in which they were to read a story and look up the meaning of individual words by freely selecting any of the different types of icons available in the multimedia glosses. A bare text was used with the glossed items for the first pilot. Comprehension questions were used to get learners to use the glosses. We recorded all screen interactions with Camtasia and took notes as learners worked on the readings.

### **Study 2**

We followed the same procedure as in Study 1. These learners were enrolled in the first semester of second-year Spanish. Learner activity was monitored using NetSupport School

software, which allowed the researchers to view the learners' screens from the instructor's station. A questionnaire was administered to analyze the interface design and learners' perceptions on the online readings.

### **Study 3**

Instructors announced in class in the middle of the semester that an online questionnaire was available via WebCT for those learners who wanted to help improve the online materials. The online questionnaire was available to learners for a long period of time in order to offer them the opportunity to collaborate in this project.

### **Study 4**

All participants took a questionnaire during their normal class period at the end of the semester.

## **RESULTS AND DISCUSSION**

This section is divided into two parts: interface design and learner perceptions. The first part focuses on the data-driven development of the three interfaces: the course interface, the readings interface, and the multimedia glosses interface. The second part focuses on learner perceptions. Data in both parts are reported in numbers and percentages of valid learner responses for each statement.

### ***Part I: Interface Design***

This part is divided into three subsections, each of which starts with a brief description of the interface in question and is followed by a brief account of the data-driven development of the interface.

#### **Development of the course interface**

The adaptation of a LMS interface to a specific learning context presents some challenges due to the limited choices with regard to both learning tools and layout tools. Choices in learning tools constrain the range of pedagogical activities that can be integrated into the course. For example, most commercial LMSs provide some sort of asynchronous discussion tool, but not voice communication tools, which clearly limits the range of communication modes natively available in the LMS to the developer. Similarly, limited choices of layout tools constrain options regarding the way the content is organized and visually presented. Despite these limitations, most LMSs provide ways to include links to external content, which may help the developer integrate a wider range of tools into the design of learning experiences. However, the integration of external tools usually presents its own shortcomings, especially if data created by external tools need to be fed back into the system (e.g., learner tracking or assessment data). After considering these issues, we decided that the creation of a specific interface for the readings was probably the best option for our particular context because it allowed us to integrate the readings using the tools we considered necessary (e.g., hide or show glosses),

and it also gave us greater flexibility in the event we decided to migrate to a different LMS or make the materials available to institutions that use a different LMS.

For the development of the course interface prototype, we first explored the possibilities for content organization and created a rough prototype of the interface's main page using the tools available in the system. The choice of tools was always informed by the content and the pedagogical function envisioned by the instructor. Once the course structure was laid out, we created a first proof of concept, discussed its main features, and made changes we considered necessary (e.g., simplified navigation structure).

The first course interface prototype was tested by asking learners to identify under which icon they would expect to find specific tools or content. The results from this study raised concerns since only four out of 12 course elements were successfully matched with the corresponding icon. Even though the key terms in the icons featured a translation in English and many of them also are true cognates in English, learners had difficulties identifying the right location of important course elements. These results informed the redesign of the second course interface prototype. The following, most important, changes were made: (a) the icon to access the readings, which represented a substantial amount of the online content of this course, was placed at the top level; (b) a section at the top level, named *Composición* 'Composition,' was moved within another section; and (c) an external link to the workbook was included at the top level. Study 4 results indicated there was some improvement in usability aspects of the interface: of the original 12 course elements, seven were successfully matched with the right icon.

Despite these improvements, further revisions are still needed since a few course elements were still not successfully matched with the correct icon. The following aspects still need attention: (a) placement of main content, (b) placement of learner training materials, and (c) placement of additional resources. Regarding the placement of main content, most learners expected the main content to be placed in the first row and appear to favor the *Bienvenidos* 'Welcome' and *Programa* 'Syllabus' icons. This trend can be seen in both Studies 2 and 4, which indicates that the concept of *Día a Día* 'Day to Day' does not represent the concept of "main content" to most learners. We will address this by changing the name of the *Día a Día* icon to *Contenidos* 'Contents' and by including a *Contenidos* icon within both *Bienvenidos* and *Programa*. We had intuitively included learner training materials in the *Bienvenidos* section of the course; Study 4 showed that about a third of the learners expected to find learner training materials under *Recursos* 'Resources,' while the other two thirds chose almost all other options. Therefore, we moved the learner training materials section to *Recursos* and created navigation redundancy by adding a link to learner training materials in all sections.

Learners' impressions about the course interface were also gathered in Studies 2 and 4 using two open-ended questions asking which aspects of the course organization and layout they liked the most and the least. The data gathered from these questions were analyzed using first frequency counts to identify salient terms and then a concordancer to better understand the context in which those terms appeared in the learners' responses. The data from the first question in Study 2 included 13 responses containing 420 tokens and revealed that the term "easy" appeared most frequently in relation to what learners found positive about the course interface. The same question in Study 4 included 60 responses with a total of 647 tokens. Patterns in the data revealed two recurrent concepts in what learners liked about the course interface: materials were easy to find/follow and organized.

No particular patterns emerged in Study 2 regarding aspects of the course interface the learners did not like. On the other hand, strong patterns emerged in Study 4, which included 57 responses with a total of 678 tokens. Frequency data revealed two salient terms:

*Chévere* (name of the workbook audio link) and *confusing*. The concordance data revealed a strong connection emerged among the terms *Chévere*, *audio*, *tracks*, *hard*, *assessment*, and *confusing*. All these bear a connection with the Wimba Voice Board, a threaded discussion board, which can be used with or without learner interaction, that was set up in order to share the workbook audio. From the learner data, it appears that what learners found frustrating was that each voice board entry was identified with an audio track number, whereas audio materials in the workbook are referred to using descriptive activity information (e.g., Dialog 1). We moved the audio into a password protected section of our Language Studies Resource Center. The audio is listed according to chapters and other, more descriptive information. Now all course sections in our LMS link to the same resource, so whenever a change or update needs to be made, it is made in only one place.

### **Development of the readings interface**

The development of the interface for the readings entailed creating templates for each discourse domain area (humanities, engineering, and business) and applying those templates to each page. Every reading is presented to learners in a single web page. The readings contain at least one graphic, all of which were either created for the project or obtained through a Creative Commons license (<http://www.creativecommons.org>).

Three items in Study 2 addressed aspects of the reading interface. The data indicated that the help section of the reading interface needed improvement, and we made a substantial revision to the help section based on these results. We included not only the explanation of each menu option, but also portions of the text exemplifying the way in which text was displayed after each of those options was selected. This revised interface was then used in studies 3 and 4. Altogether, about 30% of the learners in studies, 2, 3, and 4 consistently found the help section unclear despite the substantial changes. We believe this is due in part to the lack of a learner training component that makes not only the help section but also the menu options in the readings interface menu much more evident.

### **Development of the gloss interface**

The development of the glosses and of its accompanying gloss interface constitutes an important part of the development process since they may have an impact on vocabulary acquisition (Roby, 1999). Because the glosses are presented in a transient interface, it is necessary to gather information not only about the gloss interface itself, but also about features that may interact with the sovereign interface.

The data from Study 1 included about 4 hours of screen recordings showing how the learners interacted with the readings. The analysis of these data revealed three main problems: (a) lack of explicit mention of the item glossed in the gloss interface itself created ambiguity when the glossed item contained more than one word (e.g., *cristal reforzado* 'reinforced glass'), (b) the lack of a frame around the gloss to visually define the gloss space, and (c) the absolute positioning of the gloss with respect to the glossed item (always below the item) when the glossed item was close to the bottom of the window and users did not see the pop-up gloss window or were forced to scroll down to see it. These problems were addressed in the second prototype by (a) making explicit mention of the glossed term at the top of the gloss interface pane, (b) adding borders and increasing white space around the content of the gloss, and (c) changing the position of the gloss window when the glossed item appeared at the bottom of the screen (when the glossed item is at the bottom of the screen and there



is not sufficient space for the whole gloss to display, the code automatically places the gloss above the glossed term).

To investigate how well learners could match the gloss interface icons with their corresponding meaning, we included a picture of a gloss in the questionnaire and asked learners whether they thought the icons in the gloss interface accurately represented the concepts they stood for. Study 1 results indicated the pronunciation icon (a loudspeaker) did not represent the concept well. A different pronunciation icon (picture of a headset) was included in the second prototype and was used in studies 2, 3, and 4. Since the icons appeared to accurately represent the concept to most learners, no subsequent modifications were made (see Figure 1).

Figure 1

First Gloss Prototype Used in Study 1 (Left) and Final Prototype Used in Study 4 (Right)

chilenos y los centroamericanos. En muchas ciudades de América  
blicas que sirven de **cancha**, como los parques urbanos. Por  
fútbol fre  
chicos equ  
jugadores:  
y la Repu  
siasta. He  
a esistir  
er ejercic  
pañoles  
el tenis  
el baloncesto se asocia con los Estados Unidos, pero tambié  
**meo** anual de baloncesto.



muchas ciudades de América Latina es fácil encontrar  
partidos de fútbol. De hecho, hay lugares públicos que  
sirven de **cancha**, como los parques urbanos. Por  
Quito, Ecuador,  
A propósito, si  
s viajes por  
ento! Muchos  
buenos  
popular y se  
n Puerto Rico,  
nicana. Muchos  
caribeños miran la **Serie Mundial** en la televisión o la esc  
beisbolistas hispanos de fama internacional, como el do



## Part II: Learners' Perceptions

### Frequency using different features in the glosses

Data from the four studies consistently indicated that the learners seemed to prefer the English translation in the glosses over other available choices. The highest percentage of learners who always used the translation feature was as follows: Study 1: 83.33% (5 out of 6 participants), Study 2: 79.90% (10 out of 13), Study 3: 66.66% (14 out of 21), and Study 4: 31.25% (20 out of 64). The pictorial feature in the gloss was also selected in Study 1 as one of the features that the learners would always use by 83.33% (5 out of 6 participants). In Study 4 the trend of the pictorial feature seemed to be the second choice after the translation since 14.06% (9 out of 64) of learners indicated they would always use the picture when necessary. In Study 4, learners selected the picture (34.37%, 22 out of 64) and translation (25.00%, 16 out of 64) features as elements they would "often" use. In contrast, 67.18% (43 out of 64) and 46.87% (30 out of 64) stated they would "never" use the video or synonym features. Participants in studies 1 and 2 reported that they would probably not use the videos (33.33% [2 out of 6] for Study 1 and 75.00% [9 out of 12] for study 2). However, 47.61% (10 out of 21) of the participants in Study 3 reported that they would occasionally use the video.

### Learning vocabulary using multimedia glosses

In Study 1, all learners mentioned that the glosses helped them remember words. Five par-

ticipants reported that the picture feature was their first choice when looking up an item, but if the picture did not help clarify the meaning, they preferred to use the translation, the video, or the synonym, in that order.

In Study 2, 12 of our participants (92.30%) agreed that all modes of the multimedia glosses aided them in vocabulary learning because (a) the glosses were used in context rather than in isolation, (b) there was a plethora of resources (visual aids, stems, synonyms, definitions, and translations), and (c) since the glosses were visible aids, learners could use the multimedia mode more suitable to their learning style. Only one learner reported that the multimedia gloss did not help with learning vocabulary because he claimed they were not visible to him.

In Study 3, all participants who responded (18 out of 34) reported that glosses were beneficial because (a) multimedia glosses were very useful for different learning styles, (b) the presentation of as much information as possible about the glossed words helped recall, (c) the glosses saved time over looking up the word in the dictionary, (d) the use of different methods to learn a new word helped in retaining the information, and (e) the glosses facilitated learning about the subject of the reading text.

In Study 4 almost half (47.54%) of the responses indicated that the multimedia glosses helped them learn new vocabulary, although slightly more than half (52.50%) indicated the glosses were not useful in remembering linguistic input. These responses were surprising in light of the positive comments in studies 2 and 3 and because researchers have generally agreed that the use of multimedia glosses promotes vocabulary learning (Plass, Chun, Mayer, & Leutner, 1998; Yanguas, 2009; Yeh & Wang, 2003; Yoshii, 2006). However this discrepancy was probably caused by the learners' not using the multimedia glosses at all for different reasons: (a) learners did not know about the glosses because they missed the first week of class (b) they did not care to use them, (c) they had technical problems, (d) they rushed to complete their assignments, or (e) they used the glosses only to see word definitions, not to learn vocabulary.

### **Learner satisfaction with multimedia glosses**

Participants in all studies answered an open-ended question focused on which aspect of the multimedia gloss they liked the most and which feature they did not like. Their responses were grouped and coded according to topic. Some learners gave different reasons for preferring a combination of two modes (e.g., synonym + picture, translation + picture, picture + pronunciation). In the first study 83.30% (5 out of 6) of the participants liked the pictorial gloss best and 60.00% (3 out of 5) did not like the video because it took time while the picture offered the same information in seconds.

In Study 2, 46.15% (6 out of 13) of the participants indicated they would rather view the synonym in Spanish first followed by the picture (38.46%, 5 out of 13), although the pronunciation and translation feedback was also the preferred choice for some. In this study, 76.00% (4 out of 13) of all participants also stated that they would not use the video feature because it took too much time.

In Study 3, translation and pictorial modes were learners' first preference followed by pronunciation. However, 35.71% (5 out of 14) of the learners did not like to use the synonyms in Spanish, which was surprising because the synonym was the first choice by the participants in Study 2. Proficiency level may be one reason; the participants in Study 2 were enrolled in the second semester of Spanish whereas participants in Study 3 were enrolled in the first

semester. Some of the learners (28.50%) were very satisfied with the multimedia glosses and did not have any complaints. One mentioned that there were many unknown words in the text and that it would be convenient to have more glossed terms.

In Study 4, 45.09% (25 out of 51) of the participants preferred the translation feature, but 9 learners selected all features and stated that they liked varied resources when reading a text. A third of the learners (31.37%, 16 out of 51) also preferred the picture as a first choice. In addition, a third of the participants (28.57%, 12 out of 42) agreed with some of the participants in Study 1 (60.00%, 3 out of 5) and Study 2 (30.76%, 4 out of 13) that they were not likely to use the video feature in the glosses. In Study 4 we also learned that 15.68% (8 out of 51) of the learners did not use the glosses either because of technical problems or because they chose not to use them. They also perceived the pictorial gloss to be too small. One learner was not happy with the number of glosses and stated that many unknown words were not glossed. Five out of 42 (11.90%) of the learners expressed satisfaction with the glosses and did not have any comments about the readings.

### **Challenges reading a Spanish text**

We asked participants about their perceived difficulties when trying to understand a Spanish reading text. If learners perceive understanding technical vocabulary as their main challenge, we would give priority to incorporating more glosses of technical terms or further elaborating the texts. In Studies 2, 3 and 4, learners agreed that understanding technical vocabulary was very challenging for them (61.53%, 8 out of 13; 61.90%, 13 out of 21; and 43.75%, 28 out of 64), while understanding the main idea of the reading did not present a challenge (84.60%, 11 out of 13; 33.33%, 7 out of 21; and 56.25%, 36 out of 64). Participants in Studies 2 and 4 indicated that understanding details was somewhat challenging (92.30%, 12 out of 13 and 57.81%, 37 out of 64, respectively). In Study 3, general vocabulary was perceived as somewhat challenging by 71.42% (15 out of 21) of the learners.

### **Enjoyment and interest**

In this section, total percentages of agreement or disagreement were calculated by consolidating the options that learners had into two categories: strongly agree, agree, and somewhat agree constitutes one category (agreement), while strongly disagree, disagree, and somewhat disagree were considered another category (disagreement).

In the three studies, more than half of our participants indicated they did not find reading in Spanish boring. In Study 2 a small number of learners (23.07%, 3 out of 13) stated they became bored while reading in Spanish, fewer than half of the participants in Studies 3 and 4 agreed (38.09%, 8 out of 21 and 37.5%, 24 out of 64, respectively). We believe that reading online with the multimedia glosses will help with the problem of boredom because participants in Study 2 (84.61%, 11 out of 13), Study 3 (71.42%, 15 out of 21), and Study 4 (85.93%, 55 out of 64) agreed that the glosses increased their interest in reading online Spanish texts. We also found that learners enjoyed reading the electronic texts (100%, 13 out of 13; 52.38%, 11 out of 21; and 70.31%, 45 out of 64 in studies 2, 3, and 4, respectively). The majority of the learners in the three studies perceived that the multimedia glosses helped them understand the text (92.30%, 12 out of 13; 90.47%, 19 out of 21; and 75.00%, 48 out of 64; respectively). These learner perceptions are consistent with research that confirms that glosses are useful for understanding a text (Bowles, 2004; Chun & Plass, 1996; Lomicka, 1998; Taylor, 2006). In Studies 3 and 4, three fourths of the learners (76.19%, 16 out of 21

and 75.00%, 48 out of 64) agreed that the online texts were difficult, an indication that multimedia glosses help the learners to understand texts.

### **General perceptions of the online readings**

In Studies 2 and 3 we learned about the degree of enjoyment using the online readings. Participant answers were coded into two broad categories, like or dislike, and also by recurring themes. Twenty out of 58 (34.48%) of the participants enjoyed the content of the readings. It appears that content was an important factor in how much the readings were enjoyed. Eleven out of 58 (18.96%) of the students also mentioned interest in learning more about culture because the readings gave perspectives of life in Spanish-speaking countries they had not encountered before. Seven out of 58 (12.06%) of the participants appreciated the fact that the readings were online and always available, which helped reduce time pressure to read the texts. Learners also used strategies to read the texts quickly and mentioned the fact that software features, such as a find command, would assist them with going through the texts. A small group of learners mentioned that they liked the length and the interface of the readings. However, almost half of the participants (48.97%, 24 out of 49) did not enjoy the assignments because of time needed to complete them and because they found the assignments too difficult. Three out of 49 (6.12%) of the participants complained about the deadline for completion; 9 out of 49 (18.36%) found the readings difficult, and 4 out of 49 (8.16%) reported problems with the technology (e.g., difficulties activating the glosses, slow download, etc.). A small number of participants perceived problems with the readings themselves, such as the need for more glosses (4.08%, 2 out of 49), length of the texts (4.08%, 2 out of 49), or preference for different content (2.04%, 1 out of 49).

### **CONCLUSION**

Ten years ago, Puskas (1999) expressed the need to nourish and develop deeply applied work in CALL.

Today's standards and expectations for multimedia foreign language software are quite demanding. As a result, any concept that relegates courseware development to the status of an ancillary or an afterthought is doomed. (p. 40)

We think DBR not only helps advance the development of instructional materials to higher ground, but may also become a powerful force in the generation of theory grounded at the deepest levels of practice.

DBR has enormous potential for guiding the research and development of CALL. The four studies in this report exemplify a theory-based, data-driven approach to the design and development of materials that take advantage of the knowledge and practices generated by CALL researchers and developers.

These studies elucidate three insights into the process:

1. the importance of considering hierarchies and interdependence between interfaces  
As these studies show, the interaction between interfaces can bring about unexpected issues that may affect the quality of interaction with the system and even disrupt the learner's attention. Likewise, different types of interface call for different ways to assess their functionality within the system.

2. the ongoing nature of CALL development  
No instructional materials are ever “finished” as long as the field continues generating relevant information to improve language learning. In other words, the development of quality instructional materials is an ongoing, cyclical process that does not reach completion but rather advances to higher levels of improvement.
3. content and interface  
An effective interface is deeply connected to content, which implies that content revisions will often lead to a revision of the interface. Developers should expect that substantial content revisions will result in the need to reconsider the design and functionality of the interface.

Further research in the development of instructional materials is needed to better understand the connections between interface aspects of a tool and language learning. The principled manipulation of elements within interfaces and their impact on language learning needs to be better described and understood. Research on learner training (e.g., Hubbard, 2004) is particularly relevant to development aspects of this area. Research on teacher development also has important bearings in this area, particularly in connection with online activity design and implementation (Rodríguez, 2006).

These studies also provide insights into how learners interact with and relate to the materials. In general, learners reported positively on the use of the multimedia glosses. They were particularly positive about the availability of a variety of modes and options within a gloss. Based on this experience, we recommend making available a variety of multimedia features to expand learners’ options for interacting with vocabulary. Further studies are needed to elucidate connections between the effects of multimedia learning on learners’ perceptions and their actual achievement in understanding texts and learning vocabulary items.

Learner perceptions are an important part of the process of creating instructional materials, since those perceptions can not only help improve the efficient use of materials, but also push development toward what learners and instructors envision as enhancing the language learning process. A decade ago, James Pusack and Sue Otto (Pusack, 1999) described the difficulty of what is envisioned as the “permanent software development crisis” (p. 40), which is synthesized in the dictum quoted at the beginning of this article. As this article shows, learner perceptions play a crucial role in helping us get a bit closer to materializing what we imagine.

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