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Abstract

This paper suggests that some design features and evaluation criteria for multimedia CALL might be developed on the basis of hypotheses about ideal conditions for second language acquisition (SLA). It outlines a relevant theory of SLA and enumerates the hypotheses it implies for ideal conditions such as input saliency, opportunities for interaction, and learner focus on communication. Implications of each hypothesis for multimedia CALL design and evaluation are outlined and exemplified.

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MULTIMEDIA CALL: LESSONS TO BE LEARNED FROM RESEARCH ON INSTRUCTED SLA

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ABSTRACT

This paper suggests that some design features and evaluation criteria for multimedia CALL might be developed on the basis of hypotheses about ideal conditions for second language acquisition (SLA). It outlines a relevant theory of SLA and enumerates the hypotheses it implies for ideal conditions such as input saliency, opportunities for interaction, and learner focus on communication. Implications of each hypothesis for multimedia CALL design and evaluation are outlined and exemplified.

INTRODUCTION

CALL software designers look to research and principles from a variety of cross-disciplinary sources. Despite the potential value of diverse perspectives, SLA theory and research might also be consulted to suggest CALL design and to guide research on effectiveness. [Figure 1](#) illustrates the desired relationship between CALL design based on hypotheses about SLA, and CALL evaluation based on focused observation seeking evidence about those hypotheses. This paper outlines hypotheses relevant to CALL design and describes how they might be implemented and evaluated in CALL activities.

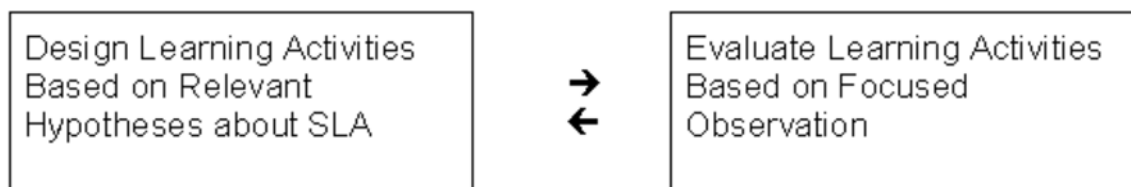


Figure 1. The interdependence of design and evaluation of CALL learning activities

RELEVANT HYPOTHESES ABOUT SLA

The SLA literature contains work representing a variety of objectives and approaches for investigating the process of second language development. For example, the recently published *Handbook of Second Language Acquisition* (Ritchie & Bhatia, 1996) contains chapters documenting 19 different approaches to SLA research. Standard texts on SLA (e.g., Ellis, 1994) include diverse perspectives. When addressing applied questions such as design and evaluation of multimedia CALL, it is necessary to select from the many approaches those that are relevant.

Identifying Relevant Hypotheses about SLA

Historically, many applied linguists and teachers have been reluctant to make *any* application of research to second language teaching, but more recently Pica (1997) has shed light on the complex issue of relationships between research and practice. She categorizes approaches to SLA research on the basis of their interface with teaching: Some SLA research *coexists* with L2 teaching while having little if any intellectual interface. Other SLA research *collaborates* with L2 teaching when teachers and researchers work together toward similar goals within the classroom and the sociopolitical environment of education. A third type of SLA research, which is most significant for CALL design, *complements* L2 instruction. Pica (1997) describes these classroom experiments in the following way:

In classroom experiments that illustrate... complementarity, theoretically grounded learning materials and strategies to facilitate L2 learning are selected or developed by researchers. The researchers then work with participating teachers toward classroom use of these materials and strategies, followed by classroom research on their impact on students' learning. (p. 54)

-22-

In applying the idea of complementarity to CALL, the "materials" refer to software and other materials supporting CALL activities. As Doughty (1987, 1992) has pointed out, these materials can be designed to operationalize conditions that researchers hypothesize as creating positive conditions for SLA. A theoretical approach that is useful in supporting such complementarity is the "interactionist" perspective on SLA theory and research (Pica, 1994).

A Useful Model of SLA

The SLA model of interest hypothesizes that target language input acts as the potential starting point for acquiring aspects of the L2. The model expands considerably on Krashen's (1982) idea that a lot of comprehensible input is what is needed for SLA. It attempts to articulate what makes input comprehensible and how it is processed to influence the development of the learner's linguistic knowledge (Long, 1996). The model illustrated in [Figure 2](#) is a simplified version of the one outlined by Gass (1997). It summarizes a consensus view among interactionist SLA researchers.

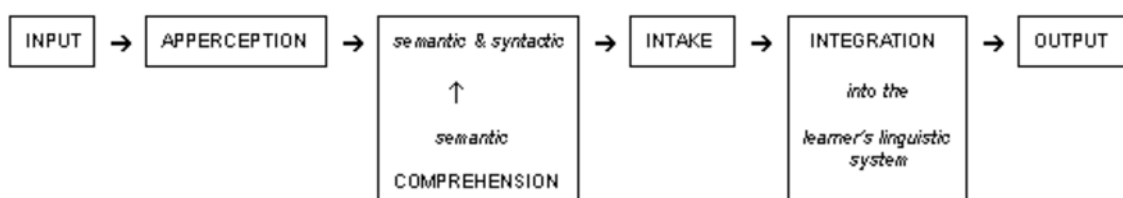


Figure 2. Basic components in the SLA process in interactionist research

INPUT at the left of [Figure 2](#) refers to the target language that the learner is exposed to. Much target language input goes over the learners' head but only that which is apperceived has the

potential to be acquired. An important aspect of the learners' APPERCEPTION is their noticing aspects of the input. Therefore, one concern for designing instructional materials may be to include features that prompt learners to notice important aspects of the language.

The next box, COMPREHENSION, represents the hypothesis that understanding of the semantic content of a message can be accomplished either with or without any comprehension of the syntax. Semantic comprehension is not expected to help in the acquisition of the syntactic system because it may be accomplished through the recognition of isolated lexical items and interpretation of non-linguistic cues. When comprehension takes place through a combination of semantic and syntactic processing, the linguistic characteristics of the input can become INTAKE, that is, comprehended language that holds the potential for developing the learners' linguistic system.

INTEGRATION is comprised of the processes for using or holding the intake in short term memory to influence the development of the linguistic system, which in turn affects the L2 OUTPUT that the learner produces. The output is an observable result of the process, but it is also considered an important contributor to linguistic development in at least two ways. First, producing linguistic output forces learners to use the syntactic system and therefore to develop this aspect of their ability. Second, it elicits subsequent input from interlocutors, some of which may contain indications of problems with the learner's output which will result in the learner's noticing aspects of the linguistic form, making new hypotheses, and producing more output. This process, referred to as *negotiation of meaning*, is believed to facilitate L2 development (Long, 1996).

Seven Hypotheses Relevant for Developing Multimedia CALL

Based on the model of SLA in Figure 2 and its supporting theory and research, hypotheses about ideal conditions for SLA can be articulated (Long, 1996; Pica, 1994) in terms that are relevant for developing multimedia CALL. These hypotheses are reviewed here and some of their empirical and/or theoretical bases are noted.

1. The linguistic characteristics of target language input need to be made salient.

Current theory advances beyond Krashen's (1982) idea that all target language input facilitates L2 acquisition by distinguishing between useless target language noise and target language input that may influence language development. The latter is different from the former because it is apperceived by the learner. Qualitative research has revealed that a learner's noticing of linguistic input plays an important role in making unknown target language forms into known and used forms (Schmidt & Frota, 1986). Experimental research has shown that highlighting input in materials to prompt learners to notice particular syntactic forms positively influenced their acquisition (Doughty, 1991). Reviews of work in this area conclude that the depth of the "noticing" issue extends to complexities of consciousness and memory, but it also seems clear that task demands that can be manipulated through instruction can increase the likelihood of noticing (Robinson, 1995; Schmidt, 1990). In other words, development of principles for CALL design methods require effective "input enhancement" (Sharwood Smith, 1991). Even though there may be factors internal to the learner that influences the likelihood of apprehension, instructional materials should facilitate apperception of input.

2. Learners should receive help in comprehending semantic and syntactic aspects of linguistic input.

Input can be defined as "the potentially processable language data which are made available by chance or by design, to the language learner" (Sharwood Sharwood Smith, 1993, p. 167). Only a subset of all "the potentially processable language data" that the learner receives is actually useful for the learner's language development (p. 167). The input that would be useful to the learner is problematic for the same reason that it is valuable: It contains linguistic forms that the learner does not know. As a consequence, the learner needs help with specifics of the input in order to comprehend it both semantically and syntactically. This help, sometimes referred to as "modification" of the input, can consist of such features as simplification, elaboration, or added redundancy (Larsen-Freeman & Long, 1991).

3. Learners need to have opportunities to produce target language output.

Like input, which can be either uncomprehended noise or valuable for acquisition, output can be produced mindlessly or it can be created by the learner under conditions that facilitate acquisition. The latter type of production is called "comprehensible output" (Swain, 1985). It is learner language that is intended to convey meaning to an interlocutor while stretching the learner's linguistic resources. In other words, not all production qualifies as valuable comprehensible output. It may be important that learners have an audience for the linguistic output they produce so that they attempt to use the language to construct meanings for communication rather than solely for practice.

4. Learners need to notice errors in their own output.

A second hypothesized value of output relates to the importance of noticing linguistic features of the target language. Swain and Lapkin (1995) describe the hypothesis as follows:

In producing the L2, a learner will on occasion become aware of (i.e., notice) a linguistic problem (brought to his/her attention either by external feedback (e.g., clarification requests) or internal feedback). Noticing a problem 'pushes' the learner to modify his/her output. In doing so, the learner may sometimes be forced into a more syntactic processing mode than might occur in comprehension. (p. 373)

This hypothesis states that the syntactic mode of processing helps learners to internalize new forms (Pica, Holliday, Lewis, & Morgenthaler, 1989) and to improve the accuracy of their existing grammatical knowledge (Nobuyoshi & Ellis, 1993). The process of noticing can occur through learners' own reflection and monitoring or through triggers provided by others.

5. Learners need to correct their linguistic output.

When errors are recognized in comprehensible output, the process of the learner's self-correction is also believed to be beneficial particularly because the linguistic items for which self-correction occurs may be those for which learners' knowledge is fragile. Error correction affords the opportunity to "focus on form" (Long, 1988). Focus on form is expected to be beneficial when it

occurs during the process of attempting to construct meanings. In other words, it is important that the language containing the noticed error be used in communication rather than for merely displaying examples of the target language. Corrections can come from learners' own hypothesis testing, from their requests for assistance from others, or from explicit correction.

6. Learners need to engage in target language interaction whose structure can be modified for negotiation of meaning.

Negotiation of meaning (Long, 1996) refers to the process of comprehending input with less than perfect comprehension, producing output with less than perfect success, identifying instances of imperfect communication and trying to resolve them. This process occurs when the normal conversational interaction is modified because of communication breakdowns.

Miscommunication, as evidenced by modified interaction, focuses learners' attention on language, and through the resolution of miscommunication, makes input comprehensible.

Larsen-Freeman and Long (1991) summarize this view of interactional modifications:

Modification of the interactional structure of conversation or of written discourse during reading. . . is a [good] candidate for a necessary (not sufficient) condition for acquisition. The role it plays in negotiation for meaning helps to make input comprehensible while still containing unknown linguistic elements, and, hence, potential intake for acquisition. (p. 144)

7. Learners should engage in L2 tasks designed to maximize opportunities for good interaction.

Research attempting to examine how learning activities can best be constructed to produce ideal input, output and interaction has pointed out the importance of particular task features. Several approaches have been taken to define significant L2 task characteristics (e.g., Skehan, 1996); however, the most useful from the perspective of input, output, and interaction appears to be that of Pica, Kanagy, and Falodun (1993). Based on a review of research on L2 communication tasks, they identified two task features that play a role in prompting valuable interactions in L2 tasks. They categorized these features under two variables--*interactional activity* and *communication goal*--as presented in [Table 1](#). The features included under interactional activity and communication goal define the characteristics of L2 tasks expected to influence learners' language in significant ways. For example, "interactant relationship" refers to whether the task requires a "two-way" information exchange for goal completion rather than requiring information to travel only "one-way" (Long, 1985). When the tasks require a "two way" interactant relationship, the quality of the interaction is superior.

Table 1. L2 Task Features and Their Definitions

Categories & Features	Definitions
Interactional activity	

Interactant roles	What are the participants' roles relative to the information that must be exchanged (i.e., who holds, and needs the information)?
Interactant relationship	What is the relationship among participants in terms of how information flows among them?
Interaction requirement	Does the task goal require request and suppliance of information?
Communication goal	
Goal orientation	Do learner use information to work together to meet a goal?
Outcome options	How many outcome options exist for the task?

This work which shows the significance of extralinguistic task characteristics in creating positive conditions for at least apprehension, comprehension, intake, and output argues for an expanded model of SLA--a model which includes relevant task characteristics. Because extralinguistic features can be devised by the instructor or materials developer, they are placed in a separate box in the revised model. The model shown in [Figure 3](#) includes the same linguistic (input and output) and learner knowledge and processes (apprehension, comprehension, intake, integration, and linguistic system) as the model in [Figure 1](#). However, this particular model adds to the psycholinguistic perspective ([Figure 2](#)) a means of expressing the task demands which influence psycholinguistic process and knowledge.

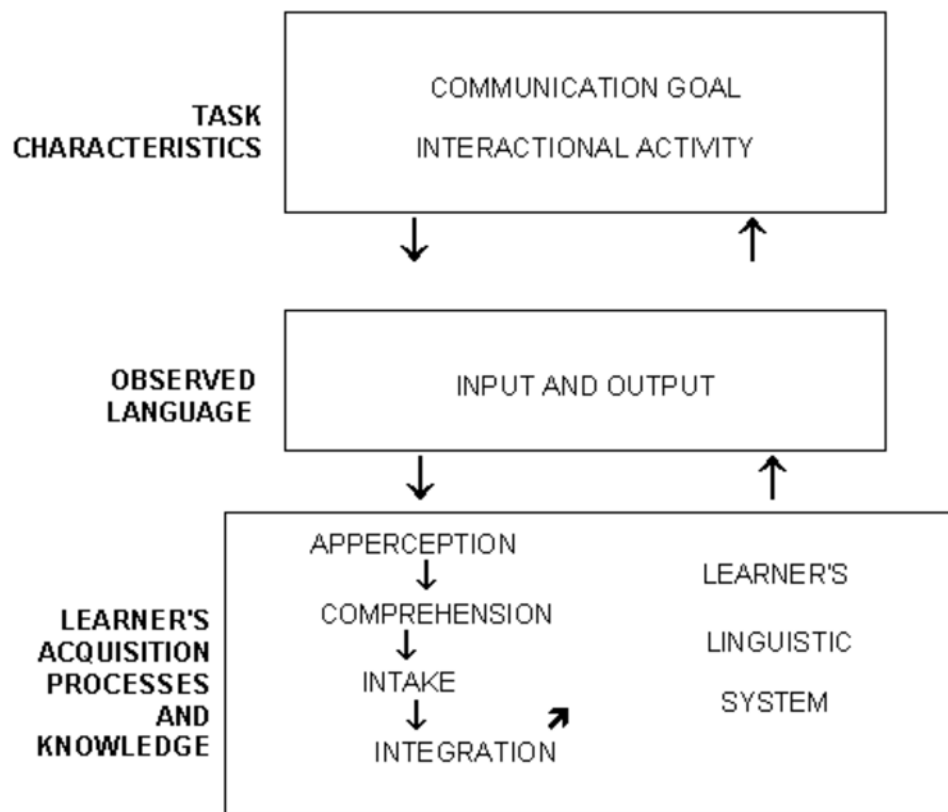


Figure 3. SLA model that separates the observable language from learner processes, and that includes task characteristics

IMPLICATIONS FOR MULTIMEDIA TASK DESIGN

The hypotheses outlined above are supported by theory and research on SLA tasks in experimental settings in which L2 learners interact with other learners or proficient target language users. They are not guaranteed to apply directly to design of CALL activities; but they may provide a valuable starting point to look for principles to apply to CALL. This section describes CALL in a way that facilitates application of the hypotheses outlined above. Two hypothetical multimedia CALL activities are used to show how the hypotheses can be implemented in the design of multimedia CALL.

CALL Software as a Participant in L2 Tasks

CALL developers need to consider how software can provide learners with opportunities believed to facilitate SLA. In other words, it is useful to view multimedia design from the perspective of the input it can provide to learners, the output it allows them to produce, the interactions they are able to engage in, and the L2 tasks it supports. Because CALL software can actually play a role in input and interaction, it is useful to consider it as a participant in L2 tasks. The metaphorical perspective of the computer as a participant provides a means for extending the hypotheses outlined above to CALL.

Examples of Multimedia CALL

To illustrate how CALL materials might be constructed to support these positive linguistic conditions for learners, examples from two hypothetical cases of multimedia CALL are given. The first example is intended for high intermediate learners of French as a second language. The software consists of a database of text, audio, and video about tourism in the province of Québec in Canada. The database is to be used by learners to study the language of tourism and travel while planning a 10-day trip to Québec. The software allows learners to type or speak questions about tourist activities in French such as *Où peut-on faire du canotage?* (Where can one go canoeing?). The language recognition procedures of the software identify what the learner wants. The search mechanism of the software then finds the relevant instances in the database and displays them on the screen as a menu from which the learner can choose. Each choice contains links to further information about a particular spot in Québec.

-26-

The second example is for high-intermediate learners of ESL who are studying in an intensive program in the U.S. or are preparing to do so. The activity is intended to teach the language of getting settled as a new student in a US university. The software is an interactive video story that takes the learner around the campus of the university and requires him or her to make decisions such as whether to live in the dormitory or an apartment, whether to have roommates or not, which classes to take, and what to say when talking to an advisor about a class schedule. The story takes different paths depending on the responses that the student makes.

Suggested Criteria for Development of Multimedia CALL

For each of the hypotheses about SLA drawn from the interactionist perspective, a corresponding suggestion for multimedia CALL can be made. Each of the following extends hypotheses that come primarily from the study of face-to-face oral communication between learners or between learners and proficient L2 speakers. As such, they attempt to describe multimedia characteristics in view of the psycholinguistic responses that they might evoke from learners rather than as exact replicas of conversations among learners.

1. Making key linguistic characteristics salient.

Linguistic features can be made salient in CALL activities by highlighting them in a different color when they appear in writing on the screen. When they occur in aural input, phrases containing linguistic elements may be transcribed on the screen, again with highlighting of the significant parts. Relevant linguistic features can be chosen by the CALL designer or the teacher. Alternatively, the software might be constructed to allow the learner to choose to see highlighted features such as the forms that are associated with formality in travel business transactions, expressions associated with evaluation of the potential sites and travel plans, or the expressions associated with travel arrangements. For example, when the learner of French as a second language requests information on where one can go canoeing, one of the options would be the Laurentide region. The video would show a travel agent who hands the learner a brochure about the Laurentides. If learners were provided with the option to make salient chosen aspects of the language, they might choose to see all the expressions showing a positive evaluation for the region. In response to the request, the program would display the first part of the description as shown in [Figure 4](#).

Imaginez, à quelques minutes de Montréal, un territoire aux mille visages. La région des Laurentides étale, avec une ostentation presque insolente, une panoplie de charme. La région offre, en plus de ses panoramas saisissants, un éventail d'attraits et d'équipements touristiques de qualité et des plus diversifiés constituant une destination touristique par excellence.

Imagine an area of a thousand faces within a few minutes from Montreal. The area of the Laurentides presents a panoply of attractions with an ostentation bordering on insolence. Besides its breathtaking views, the region offers a range of quality attractions and tourist facilities which makes it an excellent tourist destination.

Figure 4. An example of the text in a hypothetical CALL activity for planning the itinerary for a trip to Québec.

2. Offering modifications of linguistic input.

In multimedia CALL, linguistic input can be provided through either written or aural language. Modifications of input can come in the form of repetition, simplification through restatements, non-verbal cues, decreased speed, reference materials, and change of input mode. For example, in the text shown in Figure 4, "modifications" might be provided by offering definitions of each of the words in the passage and simplifications of the phrases at the learners' request. For example, *un territoire aux mille visages* (a territory of a thousand faces) might be stated as *une région avec beaucoup de diversité* (a region with much diversity). These written phrases might be modified by restating them in spoken language. In short, if the input presented in instructional multimedia is intended to expand the learner's linguistic knowledge, it needs to offer opportunities for the learner to request modifications. Multimedia CALL materials that provide these types of linguistic modifications are distinct from the "authentic" materials found on the Web because they hold the potential to provide learners with comprehensible input rather than just input.

3. Providing opportunities for "comprehensible output."

Comprehensible output--either written or spoken--must be produced with the expectation that it is going to be "understood." Under these conditions, the learner is expected to attempt to use target language forms that may stretch his or her competence. In the interactive ESL story, for example, the learner might participate in an episode with an academic adviser, who would pose a question such as "Have you decided what you'd like to take in the fall?" The learner would need to respond to the question with something like "I want to take Anthropology 204," or "Do you think I could take Anthropology 204?" The speech recognition software would need to recognize acceptable responses to the advisor's question in order to compose a reply. It is important that learners expect their responses to be comprehended if they are syntactically well-formed and pragmatically appropriate. This expectation pushes them to attempt to use the target language forms attentively and constructively.

4. Providing opportunities for learners to notice their errors.

The output learners produce in multimedia CALL needs to be analyzed by the computer and/or reflected upon by the learner to identify errors. Output containing errors indexes areas in which the learners' linguistic system contains gaps or misconceptions about target language use, and therefore these mark the key areas to which their attention should be drawn. In the French travel database, for example, the learner's first attempt at the question about canoeing might have been something like *Où peut-on fait du canoe?* (Where can one goes canoe?). Because the question in this case is written, and submitted by the learner, there is time for self-monitoring and corrections. The learner might, for example, be dissatisfied with the English version of canoe as soon as it is written and may check a dictionary for a more French-looking form to make the correction. The fact that the learner has the opportunity to recheck the question before entering it provides the opportunity to notice errors.

5. Providing opportunities for learners to correct their linguistic output.

When learners have focused their attention on their errors, they need to have the opportunity to correct themselves. They might be left to their own devices to make the corrections, but they might also be provided detailed error-specific help or access to more general reference materials. In the learner's question above, for example, the learner might change canoe to canotage, but fail to notice the grammatical error *fait* (goes) which should be *faire* (go). The program would then need to highlight this form to help the learner notice it and provide another opportunity to edit the question.

6. Supporting modified interaction between the learner and the computer.

The suggestions above imply that the learner engages in some forms of interaction with the computer. These interactions need to move the learner toward a task goal and stop progress along the way to focus on the language. Interaction can be accomplished through mouse clicks and hypertext links or through the learner's linguistic output and the software's speech recognition system. In the latter case, of course, the quality of the interaction will depend in part on the speech recognition capability of the software. For example, in the advising interview mentioned above, a successful interaction between the learner and the program will result in a fall semester schedule for the student. The program's capability for engaging in such a goal-oriented conversation with natural language would require more than language recognition at the word and sentence level. It would require a "knowledge base" about the courses, schedules, and advising routines.

7. Acting as a participant in L2 tasks.

The details of interaction need to be viewed within the larger context of the task, and particularly of the task goal and interactions. Interactions are hypothesized to be valuable when they occur in communication tasks, and particular types of communication tasks are expected to be best. This means that the tasks must focus the learner's attention on accomplishing a goal through the use of language rather than on solving problems of linguistic form. Such useful interactions occur when

linguistic difficulties must be resolved in order to solve a non-linguistic problem. Both planning a trip to Québec and accomplishing start-of-school arrangements would be considered communicative tasks from the perspective of their goals. In addition to these CALL task goals, there is a need to situate the CALL tasks within other classroom tasks. For example, each French learner might first plan his or her own itinerary for the Québec trip and then negotiate within small groups to design several alternative tours for the whole class to vote on. Learners would use the language from the multimedia activity to argue for the quality of choices made. Students who chose canoeing in the Laurentides would need to use the positive evaluative language they noticed in reading the publicity to persuade the others about the quality of their idea to canoe in the Laurentides.

EVALUATION OF MULTIMEDIA CALL ACTIVITIES

SLA research provides some clear guidance for the evaluation of instructional activities. First, empirical evaluation of learners' task use is seen as critical for making judgements about the quality of the task. In other words, SLA research would reject the practice of evaluating instructional materials through checklists of task features *alone*. Second, SLA research exemplifies research methods which can be used to evaluate CALL. This section explains each of these points and provides examples of research questions that would evaluate the quality of each of the design suggestions.

Evaluation as a Critical Part of Design

Evaluation of pedagogical materials, which is considered an essential part of their design, refers to empirical research intended to discover how successful the materials are for learners. For many years SLA researchers have made the point that the process of classroom interaction reveals essential information about the quality of instruction (Long, 1980). As a consequence, observation and analysis of L2 classroom discourse has become a mainstay in L2 research (Allwright, 1988; Allwright & Bailey, 1991; Chaudron, 1988; Day, 1986; Johnson, 1995; Seliger & Long, 1983; van Lier, 1988). Research on specific L2 tasks reflects the same methodological values (Crookes & Gass, 1993a, 1993b; Gass & Madden, 1986), with particular emphasis on the impact that learners themselves make in shaping the character of the task (Breen, 1987; Yule, 1997). The observation is that tasks are not prescribed as to the specific directions they can take and therefore learners' choices influence how a given task turns out. It follows that researchers and teachers do not have a clear conception of a task unless they observe how the task actually turns out during instruction.

-28-

Research Methods for Evaluation

Methods for evaluation include process-oriented observations of learners working on L2 tasks, and assessment of learning outcomes. One way of investigating task completion processes is to record learners' language during task completion and analyze it in view of hypothesized positive types of interactions. For example, in research on face-to-face tasks, learners completing a "jigsaw" task in which each person in a pair had to reproduce a picture used the language shown in [Figure 5](#). The researchers analyzed the functions of each of the learners' moves and their

relevance for SLA in view of the seven hypotheses described above. The second move shown in [Figure 5](#) acts as a signal to one of the learners (Taro) to stop the description and clarify the previous utterance, which he does with a repetition. This in turn prompts the other learner (Ichi) to elaborate. This type of functional analytic methodology has not been developed thoroughly for interactions that take place between the computer and a learner although preliminary exploration has been attempted (Chapelle, 1990, 1994).

<p>Taro: Its wall is completely white. Ichi: Completely white? Taro: Yeah, completely white. Ichi: It looks not wood, it looks ah concrete.</p>
--

Figure 5. An example of process data from a jigsaw task (from Pica, Lincoln-Porter, Paninos, & Linnell, 1996)

A second form of process-oriented analysis relies on introspective methods to gain evidence about learners' goal-oriented strategies while they are working on L2 tasks. These methods have been used to discover the strategies learners use for SLA in various types of L2 tasks because they provide specific task-related data (Cohen & Hosenfeld, 1981; Ericsson & Simon, 1984; Oxford, 1990; Wenden & Rubin, 1987). This methodology would also supply data about the processes learners use to work on CALL tasks as a study by Park (1994) illustrates, but much work is needed to link strategy data to information about CALL task features to get a better idea of how tasks can influence strategy use.

Assessment of learning outcomes is a critical dimension of task evaluation that requires identification of what learners are supposed to acquire as a result of working on a task. In SLA research this has typically been accomplished by the researchers' identifying target linguistic items to be acquired and then testing learners after task completion. This approach has also been used in studies of CALL such as Nagata's (1993) study of Japanese particles and Doughty's (1991) study of relative clauses. Evaluation is successful when the researcher can identify specific forms that all learners are expected to acquire. However, in many communication tasks in which learners with different needs are exposed to a variety of input and interaction (Loschkey & Bley-Vroman, 1993), a more individualized approach to outcome assessment is required. To address this fact, a more flexible form of assessment is needed--one that tests those linguistic items that *the learners choose to focus on*. This is the approach Swain (1998) takes in constructing tests specifically designed for individual students to assess their knowledge of the linguistic elements they have chosen to focus on during task completion. This method of outcome assessment must be complemented by observing learners as they complete the task.

Questions for Empirical Evaluation of Multimedia CALL

The types of process-oriented research methods used in classroom research can yield large quantities of data because they attempt to document the course of instructional process over time. It is therefore useful to be able to focus description and evaluation on specific design features. The following research questions were developed to illustrate how evaluation procedures can be developed to parallel principles of design in CALL.

1. Is there evidence that learners attended to salient linguistic characteristics of the target language input?

Evidence might consist of learners introspective accounts of what they noticed and what they thought they had learned. Evidence might also be obtained through observation of improvement in the use of linguistic items that were made salient, or observation of subsequent use of the items. For example, the learner who asked to see positive evaluative language while gathering information from the database might then be observed using expressions such as the following to convince group members to go to the Laurentides: *C'est une destination par excellence pour le canotage avec beaucoup de charme* (It's a top destination for canoeing with lots of charm).

-29-

If the linguistic items are chosen by the CALL designer or the teacher, the post-test can be constructed ahead of time as Doughty (1991) did to test acquisition of relative clauses that had been highlighted in the CALL materials. However, if the learner is going to request what will be highlighted, the post-test will have to be constructed on the basis of observation of the learner's choices.

2. Do learners choose to see the modifications of linguistic input?

Evidence for learners' requests for modifications is apparent in records of their interactions with the computer that can be stored for later analysis. For example, if the French learner requests a definition for *cadre* (view) from the phrase *Le cadre naturel enchanteur* (Enchanting views of nature), the event can be recorded as shown in [Figure 6](#). In this case, the "normal interaction" for reading a text on a screen consists of the learner receiving input, and requesting more input (i.e., turning the "page" or scrolling down). This normal sequence is interrupted, or modified, when the learner clicked on a word and then on the dictionary icon to receive a definition.

Computer:	Le cadre naturel enchanteur a inspiré une foule d'artistes. . . <i>A charming view of nature has inspired many artists.</i> ..
Learner:	Clicks on <i>cadre</i> (view).
Computer:	Le cadre naturel enchanteur a inspiré une foule d'artistes. . . <i>A charming view of nature has inspired many artists.</i> ..
Learner:	Clicks on dictionary icon.
Computer:	"Le cadre" dans cette phrase veut dire "le contexte". <i>"Le cadre" in this sentence means "setting."</i>

Figure 6. Example of a "request for modification" episode in CALL

Depending on the learner's request, the computer might deliver a modification in the form of a repetition of aural text, a simplification (in linguistic complexity, non-verbal illustrations or reduced speed of aural input) or a change of mode. Given theory suggesting the importance of

these interactions for making comprehensible exactly those linguistic items that learners need to acquire, research on the effectiveness of CALL needs to document their occurrence. One study (Hsu, 1994) investigated learners' use of "interactional modifications" in CALL by conducting a focused analysis of interactions between learners and the computer to identify their requests for modified input within a listening comprehension program. The normal interaction in this part of the program consisted of learners' requests for continuation of a story with accompanying pictures on one computer screen after another. The researcher counted as "interactional modification" sequences in which this normal interaction was interrupted by the learners' requests for repetitions, written transcriptions, or written definitions for words in the input. She recorded the specific linguistic input associated with each of the learner's requests and assessed outcomes through pre- and post-tests which had been constructed specifically to include the lexical phrases learners received in the input. Hsu found a relationship between requests for modifications and improvement on individual words. This finding stands in contrast to other studies that have found that requests for modifications are not correlated to overall post test performance on vocabulary tests (Chun & Plass, 1996).

3. Do learners produce "comprehensible output"?

Evidence for learners' attempts at producing comprehensible output might also be found in documentation of learners' work on CALL. For example, the question the French learner posed to the computer about the locations for canoeing--*Où peut-on fait du canotage?*(Where can one goes canoeing?)--is typed into the computer and can be stored along with other questions and the computer's responses. When linguistic output is produced orally, the program can record the learners' language along with the responses. Observation of comprehensible output, as it is defined in SLA research, requires learners' language used in achieving communicative task goals. Ideal cases of comprehensible output are observed in sequences consisting of the learners' unsuccessful attempts at expression followed by their linguistic modification of the form perceived as problematic.

4. Is there evidence that learners notice errors in their output?

Swain and Lapkin (1995) operationally defined beneficial output as learners' language containing errors followed by learners' language in which the errors have been modified. They argue that the benefits of such sequences derive from the learners' attention to linguistic forms for which their knowledge is incomplete. The fact that attention is paid to these forms is more important than how attention is drawn to them. The learner may be the one to recognize, without external prompting, a problem in his or her own output. In such cases, the data would display the learner's original form, the process of correction (e.g., editing), and the learner's final form. Such "self-monitoring" strategies have been found in data from CALL (Jamieson & Chapelle, 1987). The second turn of the learner in the sequence of moves in [Figure 7](#) would provide evidence for learners' noticing their own errors.

Computer: Qu'est-ce que vous voulez savoir du Québec?
What would you like to know about Québec?

Learner: Où peut-on fait du canoe?
Where can one goes canoe?

Learner: Où peut-on fait du canotage?
Where can one goes canoeing?

Computer: Il faut corriger le verbe: Où peut-on faire du canotage?
You have to correct the verb: Where can one go canoeing?

Learner: Où peut-on faire du canotage?
Where can one go canoeing?

Figure 7. Example of interactions indicating noticing of errors

5. Do learners correct their linguistic output?

The computer's second turn in [Figure 7](#) draws the learner's attention to the error with a subsequent attempt at correcting it. This sequence of error, correction, error, error identification, and attempt at correction would be considered evidence of comprehensible output. This example illustrates two instances of learners' attempting to correct their own output. In both cases these types of exchanges are possible because the learner possesses some knowledge of the linguistic item, even if it is fragile. The "canoe" error is noticed on the basis of the learner's own suspicions about the too-English-looking form she has typed. The second can be modified once the location of the problem is identified. If the learner's knowledge of a specific item is non-existent, the observed interaction might look more like the exchange in [Figure 8](#). In this case, it appears that learner does not see the problem with the verb produced until it is explicitly pointed out by the computer.

Advisor: Have you decided what you'd like to take in the fall?
 Learner: I like Anthropology.
 Advisor: You would like to take Anthropology?
 Learner: Yes, I like Anthropology?
 Advisor: You should use the expression "would like" to indicate "want."
 Learner: Oh, yes, I would like Anthropology.

Figure 8. Example of error correction as a result of explicit error identification

6. To what extent do the learners interact with the computer to engage in modified interaction focusing on form and meaning?

This question addresses in quantitative terms the extent to which the learners are actually able to use the program as an interactant in order to engage in beneficial interactions that were outlined above. A CALL program can be constructed to allow for beneficial interactions, but that program is only as useful as the interactions that actually occur when particular learners make use of it. Past research investigating learners' interactions has demonstrated great variation in the amount

of optional interactions learners engage in (Bland, Noblitt, Armington, & Gay, 1990; Chapelle & Mizuno, 1989; Hsu, Chapelle, & Thompson, 1993). Moreover, construction of the types of goal-oriented interactions illustrated by the hypothetical examples in this section require sophisticated language recognition software for the program to maintain its role as interlocutor.

7. Do learners work toward communication-oriented goals?

Evidence for learners' working toward communicative goals may be seen in the types of language sequences they produce. The hypothetical examples in Figures 6, 7, and 8 are intended to illustrate learners' interaction with communication-focused goals in a multimedia program. In each case the language or mouse-clicks appear to be moving the learner closer to finding or communicating meaning which has some purpose in view of a communicative task goal. Another way of documenting learner's goals is through their introspective accounts of what they are working on during CALL tasks (Park, 1994). Such data may be useful for showing the extent to which learners move back and forth from focusing on communication goals to noticing form.

CONCLUSION

Even though much remains to be learned about SLA, existing research results support some hypotheses that are relevant to the construction of multimedia CALL software. According to Larsen-Freeman and Long (1991), interactionist SLA

has potentially great practical importance for educators. . .since input (and the structure of conversation) is something that can be manipulated. Research findings are of interest to [second language] materials writers, [second language] curriculum developers and classroom teachers. . . . (p. 128)

-31-

This paper attempted to identify some specific implications of research findings for CALL design and evaluation that can provide a starting point for development of a complementary relationship between SLA research and CALL practice.

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